REFINER
AND NATURAL GASOLINE MANUFACTURER

OCTOBER, 1931
Vol. 10, No. 10

A Gulf Publishing Company Publication

EDITED MONTHLY AT TULSA, OKLAHOMA

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GRADY TRIPLETT
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SPECIALIZED OIL JOURNALS
Published by

GULF PUBLISHING COMPANY

OFFICE OF PUBLICATION
3301 Buffalo Drive, Houston, Texas

R. L. DUDLEY, *President*
A. L. BURNS, *Gen'l Manager*
S. W. ROBINSON, *Editorial Director*
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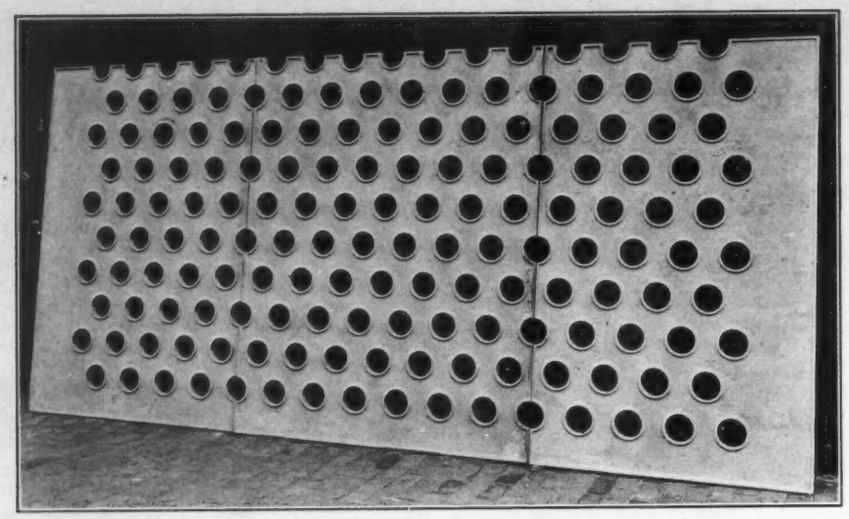
FORT WORTH, 203 W. T. Waggoner Building H. H. King, Manager.

Single copies 20 cents. Domestic and Foreign subscription price, $1.00 a year. Entered as second class matter June 16, 1923, at the post office at Houston, Texas, under Act of March 3, 1879. Advertising rates on application.



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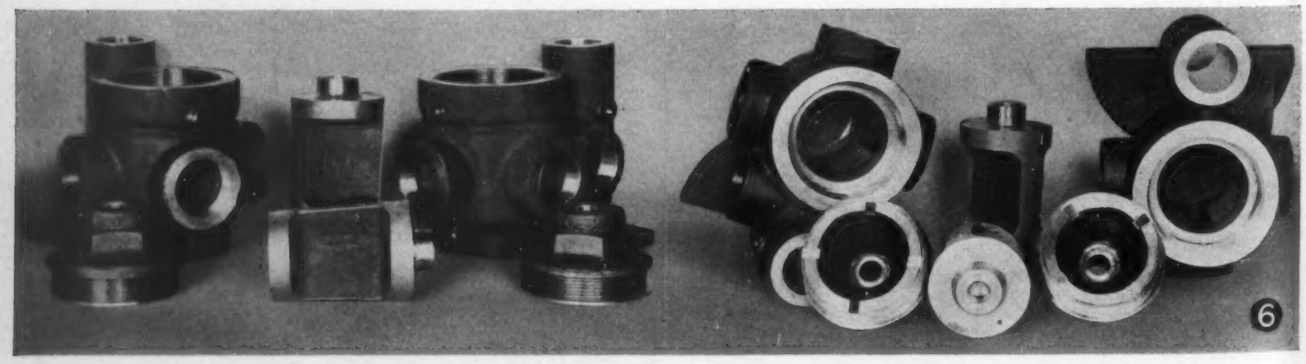

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REFINER
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Vacuum In Petroleum Refining

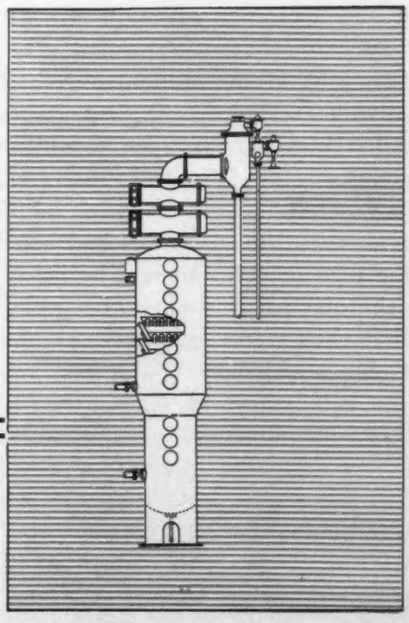
PROGRESS and development occuring within the past two or three years in the application of vacuum distillation to the processing of crude oil and the redistillation of its distillates has resulted in the utilization of vacuum units by refineries in all refining districts of the world.

Vacuum units have been designed, installed and are operating in all forms of distillation service. Applied to the preparation of lubricants first, its use has spread to the redistillation of pressure distillate, burning oils, solutions, and to the processing of asphalts, preparation of gas oils, and the production of other products.

Because of the wide spread adaption of vacuum units to the problem of distillation, and because of present interest pointing to still greater utilization by the industry, a symposium on vacuum distillation is presented in this issue of Refiner and Natural Gasoline Manufacturer.

The group of articles comprising this work includes a series of discussions relating to the general application of vacuum distillation, the theory and technology of this phase of refining, and the factors which influence its utilization as well as the results secured through its use. A second series includes descriptive articles having to do with individual vacuum distillation units. This series will be continued in subsequent issues.

There is presented in this group of articles a great deal of practical, technical and engineering information which will prove of value to the designer of such equipment, the supervisory and operating staffs handling such systems, and the refiner contemplating the use of vacuum units.



EDITORIALS

Wanted—A Plan

TWO years of economic readjustment are of themselves a blight on the business sagacity of the world. But it is even more serious that these two years have not contributed anything which will thwart still other periods of business stagnation. All that the business world knows about economics is that bad times follow good times and that good times follow bad times.

It was in October of 1929 that falling security prices served notice of a downturn in the economic curve. Shortly afterward the wiseacres of the graphs came along to inform the world, at least the United States, that the business activity curve had turned downward some six months before the stock market signal was heard.

Victor Hugo in one of his classic stories related the tragic events of a bell that rang to warn skippers of dangerous waters. But the bell could not be heard until after a ship was within the grasp of unnavigable waters. The warning came but not until disaster became a certainty.

Such is the way of the business ship. Manufacturers continue to offer finished goods into a state of falling consumption for six months before a stock market crash gives warning of disaster. Raw materials follow similar courses. It is of scant benefit to chart the course of a disastrous business cycle.

There would be some benefit in ringing the business bell at the time of the downturn in consumption. Certainly such a warning would surpass what happens now when the bell rings six months after a turn has been made. Of far greater value would be a warning or a series of warnings before the peaks of the business curve were written.

There were warnings in 1929 but these were offset by opinions that pictured world economics as lifted off the old plane of calculations. These men of the "new era in economics" outnumbered the black flag wavers and their standing was such that they were believed. Neither had facts to support his position. Some predicted disaster for a year and a half before events verified opinions. Others pictured unending prosperity for a year and a half before events made a mockery of opinions.

American industry needs a plan. Its individual industries need a plan. It should have its signals visible from the engine instead of from the platform of the observation car. Certainly the amount of gasoline needed for the United States in a year can be calculated. Economists have given advance consumption figures with accuracy.

But the plan that the oil industry and every other industry needs is something more than the reading of committee reports. Men listen or fail to listen and then go ahead producing more merchandise than is needed. Having learned much about production the business world needs to learn something about the control of production.

There is some hope in the fact that business recognizes its need for control. Although no plan has yet been offered, there is no reason to doubt that something can be fashioned that will serve as a governor on business activity. Whenever enough attention is given to the need, the plan will result.

An Old Order That Needs Reversing

IT is time for a new deal for the sales manager. His job is still that of selling whatever a refinery can produce. What he should determine is how much goods he can move at a profit.

Instead of sales volume being measured by plant capacity, plant production should be gauged by sales possibilities. The sales department should serve the function of control as well as that of outlet.

The limited authority of a sales department is not difficult to understand. Refining capacity was added to the petroleum industry in great quantities in that golden period prior to 1929. The war years brought sales departments into existence. From then until 1929, with but few minor breaks, the petroleum industry had a period when it was geared to production. The sales manager was charged with moving what the refining plant could produce. For the greater part of that time he had little difficulty.

Such days may return; but no sage of economics need be called to spread the word that a different set of circumstances rule now. No industry now enjoys the happy situation of selling whatever it can produce. There is an excess of plant capacity from railroad rails down to watch springs; and oil is within this economic current.

But the sales manager, whatever his title or his

experience, still serves the refining industry that existed from the World War until October, 1929. He is told what amount of finished material awaits movement and his duty is that of getting orders.

Evidently the habit of the executives of the oil industry is to start the week by asking the vice president in charge of refining how much gasoline is on hand. Out of that the vice president in charge of sales gets his instructions. This is a course of action that needs reversal. The day, the week, or the month should be started by the president asking the vice president in charge of sales how much merchandise can be sold. Out of that the vice president in charge of refining should be told what to do.

Another Oil Market

IT is a timely situation that has brought the refining industry into close study of oil as a material for road building. Just when the petroleum industry needs outlet for additional of its products the situation seems favorable for a decided increase in the consumption of road oil.

Road oil is not a recent product; but it is a neglected product. The impression has prevailed that only certain crudes would make desirable road oil. But the technical experts are finding methods which rob certain crude of their monopoly of road oil.

Some states, Illinois in particular, have used substantial amounts of road oil each year over a long period. Although this oil ran into high figures as to volume, the attitude of the refining industry seemed to be one of no concern. Road oil was little more than a residuum, which some road builders found desirable under certain conditions.

Now it is being demonstrated that proper materials combined with proper road oil may be used to build permanent roads of the secondary class. Completion of such a road may require several years, with each step in building a call for another application of road oil. So there is a repeat feature in the use of this product. Since the secondary road system of a state may total more mileage than its primary system, the magnitude of the road oil market must be written in millions of gallons.

Proper study of the possibilities of road oil was started by the Western Petroleum Refiners Association, which with the Tulsa Chamber of Commerce, fostered the Road Oil Congress in Tulsa, October 8 and 9, 1931. The knowledge of the road building engineer and that of the petroleum chemist must be correlated in order to bring the use of road oil to its proper figure. Soil conditions, gravel, and oil are the products to be studied. Even when these are correct, methods of construction occupy a vital position.

It would seem that the chemists and engineers of the refining industry must shortly be working with road building engineers just as they have worked with automobile engineers in the past five years. The gallons of road oil used each year may seem small when compared with the gasoline burned in automobiles; but road oil promises to become a substantial part of the output of refining plants, and the position it finally assumes will depend on what petroleum chemists learn and how well they combine their knowledge with that of the road building engineers.

Effect of Gasoline Taxes

THE adverse effect of the constantly mounting gasoline tax on the producer of petroleum is called to the attention of those producers in a letter to Wm. N. Davis, president of the Mid-Continent Oil & Gas Association, written by Harry H. Smith, general secretary of that organization. The letter conveying to the president a resume of work done and projected by the association, has a section devoted to the gasoline tax, which says in part:

"Among the new and serious problems confronting the oil industry, and one which should probably be the basis for broadened activity by this association, is the gasoline tax . . . Reports indicate that evasion, fraud and embezzlement arising out of the imposition of this tax have become so widespread and persistent as not only to threaten the revenue for roads but to create a competitive situation in which honest and legitimate gasoline dealers are placed at a devastating disadvantage. . . .

"When we have a buyers' market for crude and gasoline and the price to the public cannot be increased, the oil producer himself pays a large part of the gasoline tax through reductions in the price paid for crude by the refiners. If these purchasers cannot pass the tax on to the public because of depressed conditions, they pass it back on to the producer who, being overproduced, must accept whatever price the purchaser sees fit to offer. . . .

"The public must be shocked into a realization of the facts. How this must be done is a question. Properly framed newspaper advertising might do it but we have no funds for such a purpose and the industry may feel that it is unable at this time to supply them."

This problem of gasoline tax evasion is something for refiners to consider too. With tax evasion mounting in direct ratio to the increase in gasoline taxes, all refiners eager for better sales margins for their major product, should join the fight and aid the cause financially as well as morally.

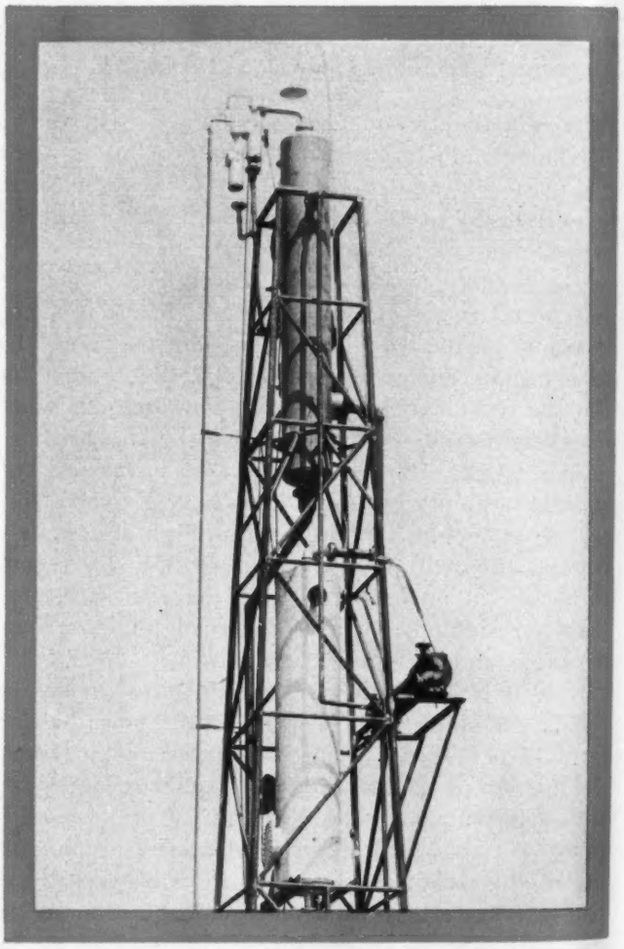
Lubricants and Cylinder Stocks from High Vacuum Distillation

SEPARATION by distillation of complex organic mixtures of high average molecular weight such as crude residuum, into a number of specification "cuts" based upon physical properties such as gravity, viscosity, flash and fire points, etc., requires a reduction of boiling point below that at atmospheric pressure, if harmful decomposition is to be avoided.

Previous to the application of pipe stills operating in connection with bubble tray columns, the general procedure (of which there were many modifications) was to reduce crude in shell stills at atmospheric pressure by straight fire distillation which removed the fractions up to and including the gas oils and perhaps a spindle oil. The topped residuum was then sent to a battery of combination fire and steam stills and slightly "cracked" if necessary to the preparation of pressable wax distillate. The proper combination of fire and steam required a highly developed technique based upon experience with the refining of particular crudes.

In a well balanced residuum three or more overhead fractions (neutrals) were separated and bright stocks recovered from the still bottoms. The "lub" stills required the attention of highly experienced operators as control was to a large degree dependent upon manual operation. By the older methods only certain types of crudes were suitable for the manufacture of "bright stocks" as the amount of treating required for the recovery from "still bottoms" was dependent upon the percentage of asphaltic material present.

Present wide spread adoption of pipe stills operating in conjunction with bubble tray columns under high vacuum either with steam (wet vacuum) or without steam (dry vacuum) had its origin for three principle reasons namely, (1) to conform "lub" distillation to the already existent continuous methods of fractionation in use for the separation of gasoline, kerosene and gas oils at atmospheric pressure, the superiority of such methods having previously been amply demonstrated, (2) to increase the number of crudes from which high grade lubs, bright stocks and cylinder stocks would be recovered and in general to extend the potential supply of lubricating raw material and (3) to improve the quality of products and lower the cost of manufacture.



LUBRICANT RECOVERY PROBLEMS

Fractional distillates from a given crude increase in complexity from the initial to the "end" point. The heavy higher boiling constituents are less heat stable than the lighter constituents. Simple or "batch" distillation, (into which category the laboratory Hempel distillation falls as well as straight fire distillation from shell stills) necessitates the progressive removal of constituents, the boiling points of which become higher as the distillation proceeds toward the end point. In such distillations the introduction of steam lowers the boiling range by modify-

Stocks Recovered Under Vacuum

By I. N. BEALL
Chemical Engineer

ing the partial pressure conditions in the system. The degree of boiling range depression is dependent upon the proportion of steam used. In general it is just a simple distillation using a current of inert gas. Insofar as batch crude residuum distillation is concerned, the use of steam solves the problem of lowering the boiling range but does not solve the problem of progressive increase of boiling point of the unvaporized portions. This means that heavier cylinder stocks become more difficult to recover without decomposition as the firing is continued.

When crudes are subjected to simple distillation at atmospheric pressure a point is reached (dependent upon characteristics of crude) where "cracking" becomes evident. In general the "safe" point is somewhere below 600° F. ranging on down to 400° F. or even lower in the case of "freaks." If distillation is to proceed further without excessive decomposition, the entire pressure on the system must be lowered or partial pressure conditions established by the injection of inert gases or vapors of higher volatility.

Where liquid mixtures are heated in pipes the vaporization is progressive throughout the circuit but the vaporized portions remain in contact with the unvaporized portions. Inasmuch as the vapors first formed must obviously be of higher vapor pressure than the unvaporized liquid, partial pressures are maintained and additional vaporization of the heavy portion occurs at a lower point than if the lighter vapors had been removed from the system as fast as formed. In other words, total vaporization is a matter of average boiling point rather than the boiling point of any one fraction as in simple distillation. The net result is that the per cent vaporized for a given temperature is much greater than would be in the case of "batch" distillation. This is one distinct advantage pipe stills have over any type of "batch" distillation. Another point of superiority of the pipe still is in the matter of heat transfer.

The only justification for the use of sub-atmospheric pressure for residuum distillation is to prevent injuries to the recovered stocks due to excessive "cracking" of the more viscous constituents. This is reason enough. A certain degree of "cracking" is in most cases beneficial as it rids the residuum of constituents too unstable to be included with lubricants and also insures pressable wax distillates. This is particularly true of crudes of which Tonkawa crude and Salt Creek crude are typical. The petroleum division of the U. S. Bureau of Mines has made studies of typical crudes from every field of consequence and also in many instances from the various producing horizons. These analyses which are too familiar to need description here, are compiled in various reports of investigations, bulletins and technical papers by that department. As a basis of comparison, these

IN this article by I. N. Beall, chemical engineer, dealing with the problems attendant to vacuum distillation procedure the writer has made no attempt to prepare a complete and comprehensive treatise on the subject. The objective which was requested of Mr. Beall, was rather to touch upon some of the high points not covered in present literature on the subject of preparation of lubricants by means of vacuum distillation.

The author has dealt to a certain extent, with the fundamentals of the subject before discussing the engineering and technical phases of the work. He includes practical suggestions for the design, construction and operation of "wet" and "dry" vacuum units, discusses such practices as flow of oil through the unit, reboiling, refluxing, heat exchange, the use of steam, and discusses the applicability of such heating media as diphenyl and mercury. Vapor pressure curves for various conditions are presented, as is a typical diagrammatic flow chart of a "dry" vacuum unit designed for the preparation of lubricants by vacuum distillation.

analyses are of great value, but are in no sense a complete assay. The adopted procedure is to carry the atmospheric distillation up to 527° F. and then distill the remaining residuum up to 572° F. under an absolute vacuum of 40mm, mercury (1.6 in. abs.). The average reduction in boiling range between atmospheric and 40mm. is between 125° F. and 180° F. The depression of the average boiling point by increase of vacuum can be approximated by plotting the values obtained from the reciprocal of the absolute temperature in degrees Fahrenheit — 60, against the logarithm of the corresponding vapor pressures. In other words

$$\frac{\log 10P}{T° \text{ F. abs.} - 60} = k$$

The average boiling points taken from the distillation of a sample of residuum at two pressures, say 50 and 25mm. will in general suffice to define the curve which is very nearly a straight line. From such a curve the average boiling point at other pressures can be predicted by extrapolation.

Cracking is influenced by time temperature and pressure. In the continuous fractionation of residue for "lub" recovery, the objective is to increase the rate of heat transfer by passing the oil at high velocity through the pipes in the furnace. In the final heating zone, the effort is to get a uniform distribution of heat and to keep the temperature difference between oil and furnace to the lowest practicable minimum. This means that the B. t. u. transfer per square foot per hour is small and a greater length of pipe must be used than for normal heating. As a consequence the pressure drop due to the velocities required is much higher than for ordinary high pressure cracking. The success of a vacuum installation is dependent as much upon the pipe still as the fractionating column.

VAPORIZATION

Molecular latent heat of vaporization has frequently been used as a constant, but to do so leads to serious errors. The term, latent heat of vaporization, is embraced in the broader term, latent heat of expansion. On distillation liquids pass into the vapor form. When the pressure on the system is high, the volume of vapor per unit of weight is small and for every change in pressure, the volume varies as also does the temperature required for vaporization. At low pressures the vapor volume is great as compared to the liquid volume and inversely the opposite condition exists at high pressures. Thus at a point approximately 11° F. from the critical, the latent heat of vaporization becomes zero, increasing progressively in value for every point of lower pressure. In view of the low pressures carried on "lub" fractionators, it is not surprising that the temperature drop at the feed should be as high as 300° to 350° F. as all the vaporization takes place after leaving the furnace, at the sacrifice of B. t. u. in the oil itself. Even though the pipe passage is unrestricted, the pressure drop across the point of feed must be high due to sudden decrease of velocity.

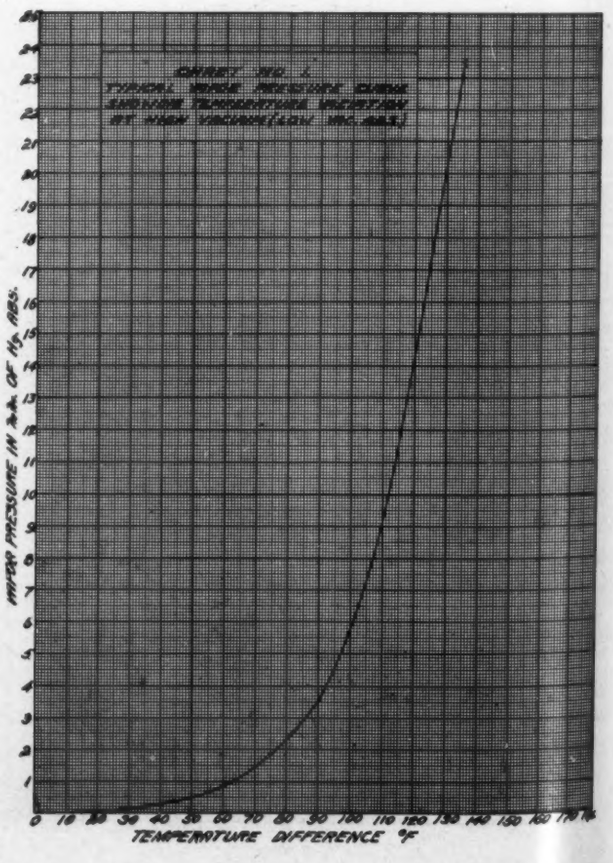
On the other hand the molecular weights of the lubricant components are very high. According to Avogadro's hypothesis, the gas volume of one mol is the same for all substances when reduced to the same temperature and pressure conditions. The physical properties such as gravity, boiling range, etc. indicate that the molecular weights of the lubricant components vary from 250 to 500 and that 400 may be taken as an average molecular weight approximation for practical application to the calculation of heats of vaporization. In short, the volume of one average mol-pound is between 45 and 60 gallons in the liquid state. Striking an average of say 55 gallons per mol of 400 pounds and using the established constant of 373 cubic feet mol-pound vapor volume at 760mm. or 30ms. the vapor volume can be calculated at other temperatures and pressures. For example at one inch mercury pressure absolute and 550° F., the calculation would be:

$$\frac{373 \times 30 \times (520 + 550)}{520} = 23026 \text{ cubic feet.}$$

or

$$\frac{23026}{55} = 419 \text{ cubic feet per gallon.}$$

The actual vapor volume appears to be somewhat



less than that calculated, so for engineering purposes within the bounds of allowable error, the vapor volume of one barrel may be taken as 15,000 cubic feet at 550° F. and one inch of mercury. This figure is useful for purposes of preliminary estimation. Thus, for example, for vaporization of 5000 barrels per day the column with a free space vapor velocity of five feet per second, the diameter of the column required would be

$$\frac{15000 \times 5000}{86400 \text{ sec./24 hrs.}} = 870 \text{ cubic feet per second.}$$

$$D = \sqrt{\frac{870}{.7854 \times 5}} = 14.6 \text{ feet diameter.}$$

The approximate vapor uptake and cap slot area can be approximated in a similar manner based upon the allowable velocities through these elements. Low vacuum requires either the use of large diameter columns or of high velocities. The latter is not permissible because of high pressure drop.

SPRAY

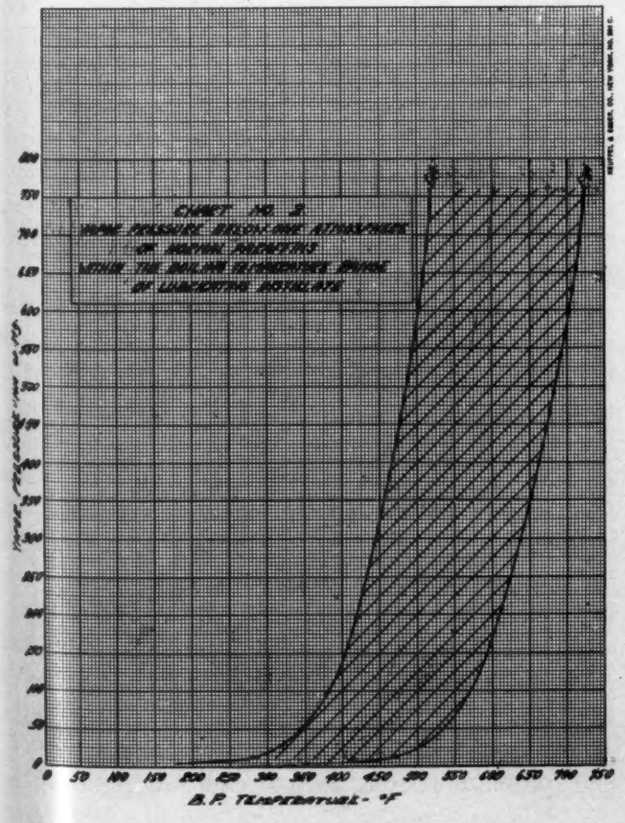
The lower the pressure on a distillation system the greater becomes the tendency to spray. This is due to the high velocity with which the molecules leave the liquid to assume the vapor state and also to the fact that small variations in pressure effect relatively great changes in the boiling temperature in the low pressure ranges. Charts Nos. 1, 2 and 3 illustrate how the vapor pressure varies with the temperature at pressures below one atmosphere.

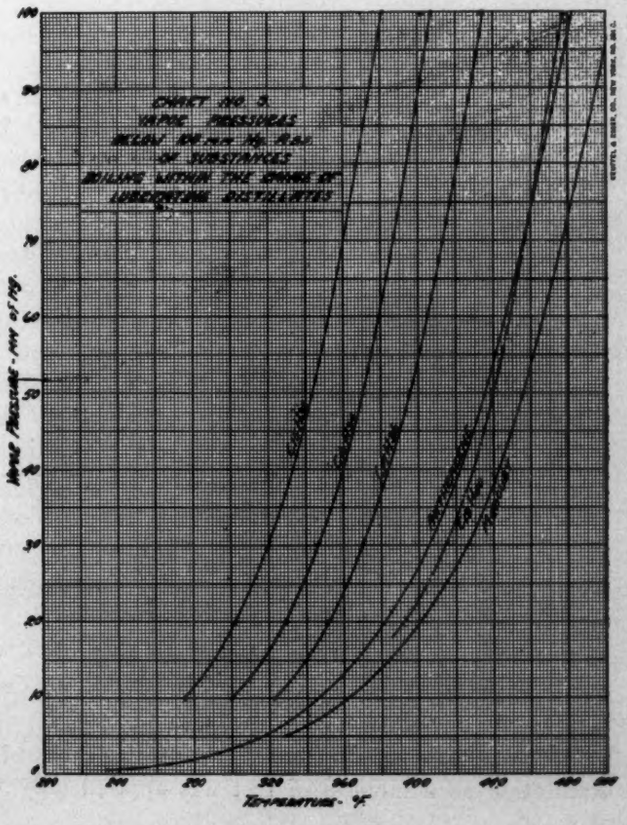
In general the vapor pressure curves of all substances assume a fairly uniform flexion neglecting the temperature and pressure. Even on a laboratory Hempel distillation at 40mm. absolute, a very close regulation of vacuum is necessary in order to prevent the charge being "puked" from the flask. The reason for this is that the boiling ceases when the vacuum is momentarily released. When the vacuum again reverts to the original a superheated condition causes sudden ebullition and the charge leaves the flask via the condenser.

Mechanical agitation by steam or other inert gas or by mechanical means prevents the "bumping" due to variable vacuum. This one point at least which would favor the use of steam or in other words "wet vacuum" as compared to "dry vacuum". There are certain other advantages in the use of steam depending upon its method of injection. Superheated steam has a brightening effect upon the distillate.

REBOILING

The most efficient forms of fractionation require a heat supply at the bottom to work in conjunction with the cooling required at the top of the column. In other words the amount of reflux is dependent upon the heat units delivered by the reboiler and the heat units dissipated by the reflux condenser. The solution of problems connected with reboiling and reflux have required the exercise of considerable ingenuity. Steam for the reboiler is not practical because of the high pressures necessary to maintain





the temperature difference required for heat transfer. The coefficient of heat transfer is very high from a condensing vapor through solid containing walls, therefore steam, because of its availability and high latent heat is used where the transfer area must be limited as in the case of column reboilers.

Either diphenyl or mercury because of their high boiling points and resistance to decomposition at high temperatures are suitable for use in reboilers for residuum fractionating columns. Usual practice in present installations is to supply the additional heat for reboiling by recirculating the reheated bottoms supplemented by superheated steam and the reheated condensate from the primary condenser. The heat transfer is by direct admixture and contact and hence very efficient. Additional vaporization results from the decrease of average volatility caused by the injection of light condensate and temperature drop incident to vaporization is avoided by the recirculated hot bottoms. The superheat of both steam and vapors also assist in supplying the heat absorbed by vaporization.

REFLUX

Generally accepted practice is to recirculate a portion of the stream from the run-down plate immediately above to the top tray of the section below. The top tray receives a portion of the condensate from the primary overhead condenser. In residuum fractionation the products are drawn from the bottom plate (run down or seal plate) therefore, the closest practical approach to the established practice in other forms of fractionation where the product is overhead condensate which furnishes the return reflux to the top plate is to return the draw off from the plate above.

In "wet vacuum" distillation the revaporization on the run down plate is sometimes assisted by the direct injection of superheated steam, the aim being to so balance reflux and steam as to get a uniform draw off in the run down tanks. Control is based upon the viscosity, gravity, flash point, and fire point of the steam. Closer cutting between streams is obtained by increasing both the steam and reflux return rates. The superheated vapors from one of the overhead condensers can be used for "dry vacuum" distillation to replace steam. The heat exchangers can be so arranged as to compensate for the additional heat input required when hot vapors are used. Reboilers using diphenyl or mercury on the run down plates (collecting pans) should prove beneficial provided a sufficient depth of oil is used for immersion of the heat transfer elements.

Fortunately, lubricating stocks do not have to meet distillation specifications such as apply to motor fuel, or the withdrawal of side streams would be unsatisfactory. So far the only application of vacuum distillation as a method of test has applied only to control work and the analysis of column efficiency. There is no such thing as "gapping" between initial and end points of consecutive cuts such as is in the separation between gasoline and kerosene with efficient fractionation of crude at atmospheric pressure.

OPERATING PROCEDURE

Operating procedure is determined by the nature of the crude, the products to be obtained, and the equipment available. The vacuum column is most frequently used in conjunction with the atmospheric column as follows: The raw crude is pumped through heat exchange with overhead, side streams and bottoms from the vacuum columns in consecutive order beginning with the primary condenser. The crude passes from the bottom discharger to the atmospheric pipe still at a temperature within the range of 350° F. to 425° F. where the temperature is raised to that required for the fractionation of light products. Sometimes a light export grade gasoline is fractionated out of the crude after heat exchange before the crude enters the atmospheric pipe still. In the atmospheric pipe still the crude is brought up to a temperature of 450° to 500°F. after which it is fed to the column. Gasoline is recovered by condensation of the overhead vapors, kerosene or light burning oil from the side stream and gas oil from the bottom side stream. Spindle oil, solar oil or light lubricating distillation may also be withdrawn from lower side streams.

The topped crude or long residuum is then picked up by a hot oil pump and forced through the vacuum pipe still at high velocity. From the pipe still the oil passes to the lower part of the column through a distributing header beneath the grid plates. Feed temperatures vary between 775° F. to 825° F. — 800° F. is a fair average approximation. For wet vacuum distillation steam may be added through perforated pipes inserted in the furnace tubes located before the radiant heat section. The use of steam retards decomposition, increases vaporization and brightens the stock. Bottom steam may also be used, although such practice has fallen into disfavor due to the increase of spray and entertainment. Where the raw crude residuum is low in asphalt content as in the case of the paraffin base (Pennsylvania), napthene (Gulf Coastal) and some of the Mid-Continent mixed base, the bottoms are bright stocks suitable for heavy steam cylinder stocks after treating. The high asphalt content crudes furnish bottoms suitable for heavy fuel oil, or treating with sulfur, air blowing and refluxing to commercial grades of asphalt.

The cylinder stocks are recovered from the first collecting pan above the grid plates. As many as five lubricating distillates may be recovered from the side streams and the primary condenser, the viscosity and specific gravity of each stream progressively de-

creasing from each collecting pan from bottom to top. Steam is sometimes used in the cylinder stock pan just above the grid plates for making this cut heavier. The condensate from the secondary condenser consisting of light gas oil is returned to the gas oil from the atmospheric still. A heavy gas oil, light "lub" or paraffin distillate may condense in the primary condenser.

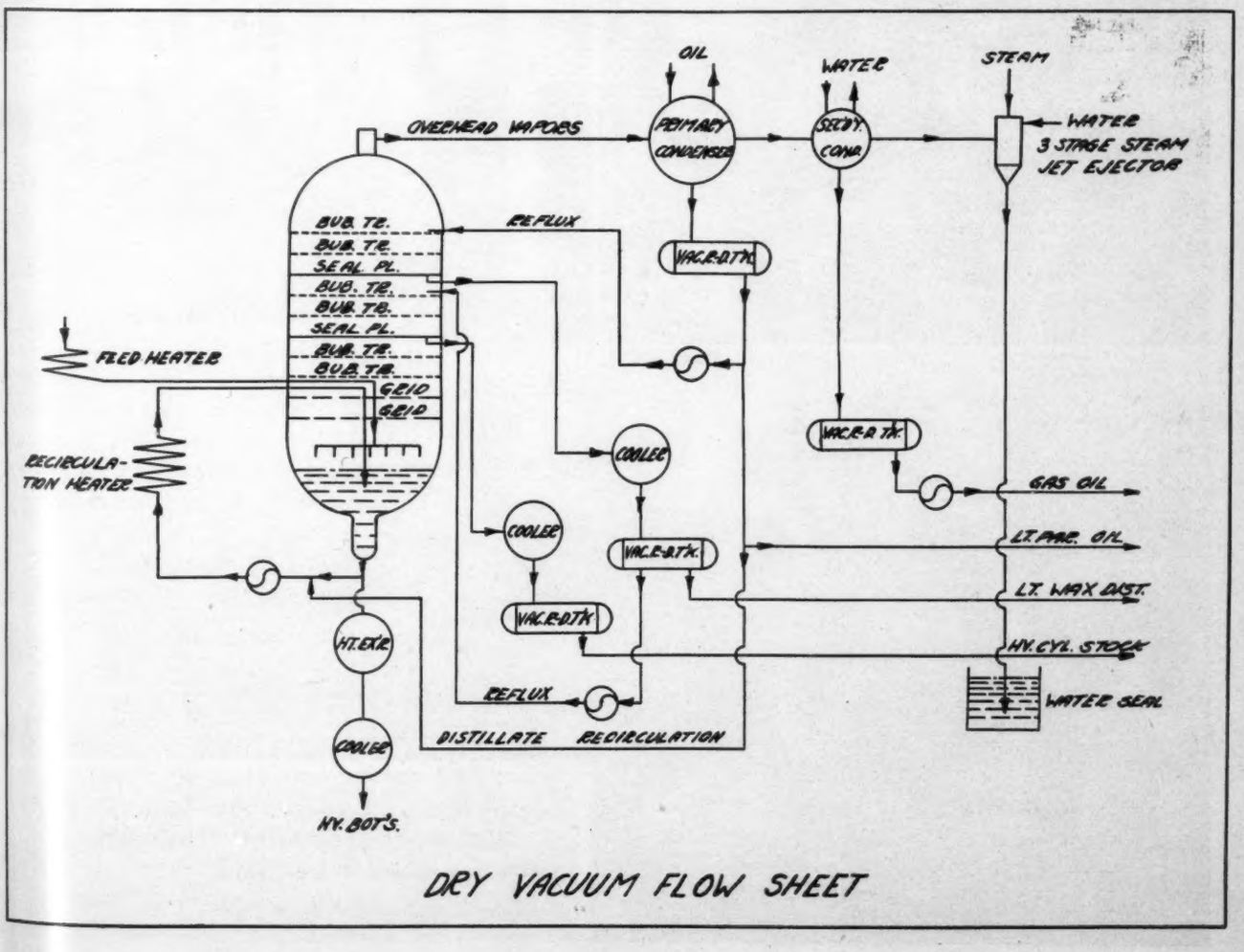
In some cases a wide cut is taken from the vacuum flash column. This makes the separation between th lubricating stock and the asphaltic residue. After dewaxing, the mixture of unfractionated of long cut "lub" stock together with the solvent naptha is heated to 725° F. to 775° F. and fractionated into specification cuts at atmospheric pressure or under slight vacuum. The naptha retards cracking and assists vaporization by raising the average volatility of the mixture.

Some crudes are well balanced, others are deficient in certain fractions. The typical paraffin base and napthene base light crude residua have a tendency to run low in the higher viscosity fractions. The reverse tendency is true with the typical heavy asphaltic residua. Close fractionation will give a greater viscosity and gravity spread between cuts.

Multiple steam jet ejectors with tubular surface condensers between stages with a final stage condenser are widely used for evacuation. The usual practice with "wet vacuum" is to use a barometric condenser ahead of the steam jet ejector. Three stage ejectors are used for "dry vacuum" and two stages for "wet vacuum." The three stage type is capable of furnishing vacua above 29 inches or less than one inch mercury absolute. The two stage ejectors furnished steady vacua around 28 inches. Hot well multiple stage centrifugal or impeller type pumps are used for the withdrawal of condensates and from the vacuum run-down tanks. The same type is also used for the withdrawal of "bottoms" from the column.

Condensers for the overhead vapors have exceptionally large condensing surface. This is necessitated by the attenuated vapor condition due to high vacuum, as the efficiency of heat transfer is determined by number of molecules which impinge the surface and yield up their quota of heat units over a given period. The molecular concentration diminishes in almost direct proportion to the degree of absolute vacuum. The raw crude is frequently used as the cooling medium through the tubes of the primary condenser and water through the tubes of the secondary condenser. From 20 to 40 square feet of condensing surface per barrel of condensate per hour

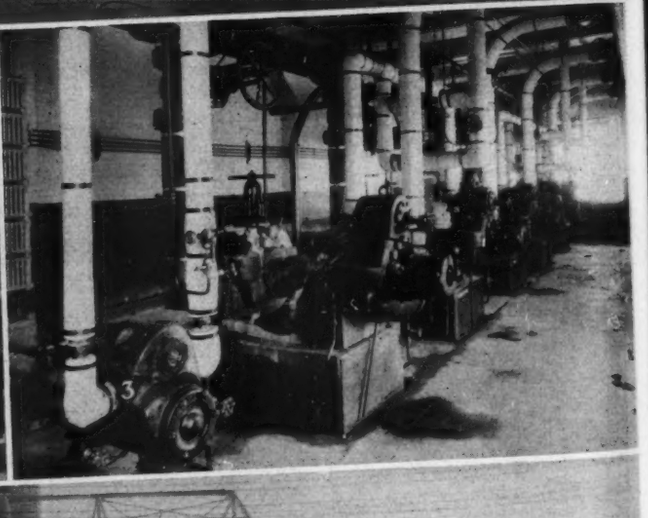
(*Continued on page* 116)



DRY VACUUM FLOW SHEET

Vacuum Distillation of

GULF REFINING COMPANY'S



1—Gulf Refining Company's 8,000-barrel pressure distillate vacuum rerun unit at Toledo, Ohio.

2-3—Pump Houses, Toledo, unit.

4—Toledo unit viewed from rear.

locality. The oil contains no gasoline. The lightest fraction distilled is a 24/26 gravity Diesel or furnace oil. The heaviest, or most dense material, is the mineral rubber. The oil as it comes from the ground has a gravity of 11 to 14° A.P.I., a cold test of 30°F., is produced from a horizon 1100 to 1200 feet, contains up to 70 per cent water. Several types of dehydrators are being utilized in the field, principally those depending upon the use of heat as the medium to effect the separation of water from the heavy asphaltic oil. The field is well defined, covering only a small area, with the wells producing from a few barrels up to 150 barrels per day each.

In 1928, the first part of this plant was constructed. At that time no specific information was available concerning this crude in particular, or the manufacture of asphaltic compounds in general, excepting the formulae and processes worked out in other plants operating on a different form of raw material. The equipment installed at that time was of Southwestern Engineering Corporation design, having a pipe still, heat exchangers and an evaporator. This preliminary set-up was to effect the separation of the light furnace of oil fraction from the crude so that it could be processed in the blowing stills or converters set back from this equipment.

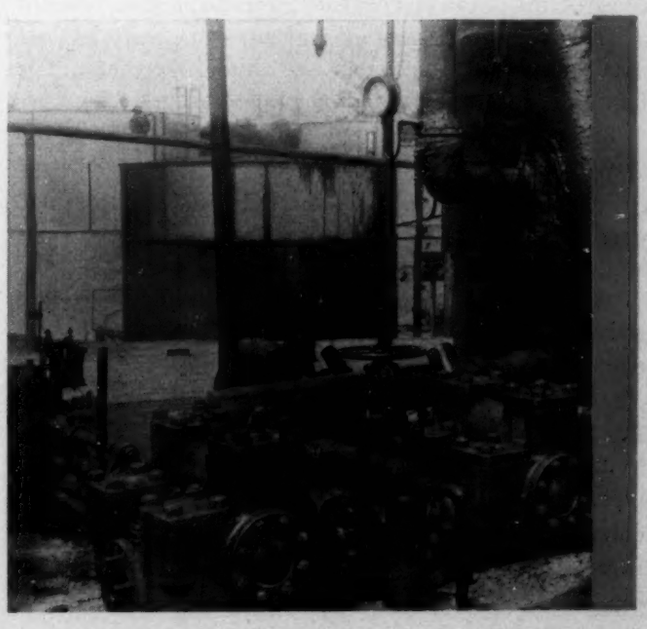
VACUUM UNIT

To effect a further separation of other light fractions from the heavy residuum or flux, a vacuum still was installed in the latter part of 1930. Through this additional equipment, two lube distillate fractions are removed from the crude: one called the light lube, coming from overhead; and another called the heavy lube removed as a side cut from the main vacuum tower. With this installation the blowing time is materially decreased while a better grade of material is manufactured in the oxidizing stills. The original stripping or skimming equipment was permitted to stand in the original position, with the vacuum installation being set so that the residuum from the stripper could be pumped directly to the blowing stills, to storage, if found necessary, or fed directly to the vacuum tower from the evaporator.

After the crude has been received in the plant storage free from water, or has been dehydrated at the plant, it is kept at a temperature sufficiently high that it is fluid enough that pumps may pick it up without difficulty. This is effected by exhausting steam into the tanks just above and around the suction lines through a semicircular series of pipes extending into the tanks. These pipes are welded into the sheets of the storage and are welded or bull plugged at the ends extending into the oil. Exhaust steam is fed into these pipes through smaller ones extending into them so that the steam is carried to the farthest end, then permitted to return to the atmosphere. With this arrangement, the fluidity of the oil is maintained without additional heating.

In operation, the heavy asphaltic crude oil charge is picked up from the heated storage by a Dean Brothers nine by 5½ by 12 simplex reciprocating steam pump, the speed of which is regulated by a recording Foxboro flow controller. This controller is placed on an instrument board next to the instrument that governs the amount of fuel fed to the pipe still, and operates through a remote control to the pump, which is set near the tanks holding the crude oil in storage. Flowing from these charging pumps, the oil at around 125°F. enters the bottom section of the heat exchangers, Southwestern enclosed tubular units, three of which are set on a superstructure above the evaporator. Between the lower and center one of these exchangers there is placed a sediment tank through which the crude flows removing from the oil the suspended matter remaining after it has been passed through the dehydrators in the field and at the plant. Passing through the remaining two units of the exchangers, the crude enters the pipe stills, where it is heated sufficiently to remove that portion of the light fraction desired.

Holding a temperature on the oil just below the point where it begins to crack, it enters the evaporator at approximately half the distance from the skirt to the top, flowing downward over the trays to the base to come in contact with superheated steam at a temperature of 900°F. injected into it, removing through agitation and the action of partial pressures the Diesel, or furnace oil, contained in the crude. Those vapors rising through the series of plates above the entrance of the crude charge, emerge at the top of the evaporator to pass downward through the three heat exchangers, which are condensers for the vapors. Flowing directly from them, the distillate is carried through a line to the tankage provided for it. This distillate may be utilized as fuel in the boilers, pipe still and oxidizing converters should the supply of gas be cut off for any reason. Normally, the distillate is shipped to outside markets to be utilized as furnace oil or Diesel fuel. The low cold test on this



Base of Vacuum tower showing short hook-up on pump connections removing residue from tower.

product removed in the process of stripping the asphalt charge makes it an ideal fuel to be used in those states where the winters are severe.

RESIDUUM PROCESSED

The residuum or bottoms in the evaporator were removed in the beginning of operations through a float-controlled valve placed close up to the equipment. The float and chamber were of conventional design, well insulated, and placed outside the tower as in ordinary oil refining. However, during cold weather soon after the original installation, it was found that the oil in the float chamber became so viscous that the action of the float was retarded, and at times was held up entirely. Consequently, the unit was shut down after the trouble was located. The float mechanism was removed from its position, a hole was cut in the side of the evaporator near the original connections, large enough that the flanged part of the float arm chamber of the control could be bolted to the shell of the evaporator. The float now extends squarely into the interior of the evaporator, being acted upon by the mass at operating temperatures. No matter how low the mercury runs in the thermometers, the float is in perfect action at all times. The valve in the line leaving the evaporator was not changed, so the action in permitting the residuum to flow from the evaporator is the same as in the original installation.

After leaving the float controlled valve at the base of the evaporator, the residuum or partly stripped flux as it is called in asphalt manufacture, is led directly to the vacuum tower, to the blowing stills, or, if necessary to the unfinished flux storage. In normal operation, since the installation of the vacuum equipment, this flux is drawn to the vacuum tower by the vacuum on the tower itself, propelled by the release of the material in process under the regular working pressure of 15 pounds, gauge. As the vacuum equipment was placed close up to the stripping tower, or evaporator—made necessary on account of the heavy oil congealing rapidly, and on account of friction set up in long lines of pipe—the material does not have far to travel from one unit to the other. The flux in process enters the vacuum tower near the base of the enlarged section where it is acted upon by vacuum in varying degrees of intensity.

Superheated steam is injected in the base of the small part of the tower as well as in the base of the large section. The action of the steam permits the withdrawal of two lube distillate fractions from the flux in process, stripping more or less, depending upon the needs of the plant, as in the application of the vacuum on the tower. The vacuum tower as well as the side stripper set alongside it was designed by J. P. Devine Manufacturing Company, while the jets or vacuum equipment is Elliott type. The overhead stream removed from the tower enters the tubular condensers where it is liquefied before entering the ejecting apparatus, falling downward into a surge tank placed below the condensers to be removed by a Dean Brothers pump. It is cool enough that it may be placed in storage without further treatment.

From a blank tray approximately one-third the way up the large tower there is removed another cut of lube distillate. This is heavier than the overhead, and carries with it a small amount of the light fraction belonging properly to the overhead stream. To correct this condition, a small stripper tower is placed beside the large one, with the vacuum connection leaving the top of it to enter the large tower about two-thirds of the way up, removing from the side stripper those light fractions with the assistance of superheated steam injected through the control nozzle placed in the base.

The heavy lube cut remaining in the base of the side stripper is removed continually by a pump set close to the bottom. Setting in a horizontal position between the side stripper and the large vacuum tower is a heat exchanger through which the heavy lube cut is cooled before being pumped to storage. The cooling is effected by water pumped through it by the boiler feed pumps, heating the water before entering the boilers, and cooling the lubricating oil distillate at the same time. This arrangement lessens the work performed by the feed water preheater, utilizing heat that would otherwise be wasted.

MAINTAINING VACUUM

The ejectors maintaining a vacuum on the large tower, and transmitted to the side stripper through the vapor line connecting the two, are operated by steam with a barometric column placed from them extending to the ground. Water is pumped to these heads in order that the steam may be condensed, thereby increasing the vacuum or maintaining it at the point originally brought about by the action of the steam in the jets. A spray pond was excavated a short distance from the unit by which the water may be kept at a temperature low enough that it is efficient in assisting with the vacuum application. A battery of Marley low pressure spray nozzels were installed, supported on a wood structure built in the center of the pond. The water is circulated by two Dayton Dowd centrifugal pumps placed on the same shaft. At one end of this shaft was attached a 30 horsepower Allis Chalmers electric motor, while on the opposite end of the same shaft is a 30 horsepower steam turbine. The motor is utilized at all times excepting when an electrical storm interrupts the delivery of current to the plant. Immediately upon interruption, the turbine automatically cuts in, carrying the load of the pumps without cutting out the ejectors for the lack of water.

As the residuum or stripped flux builds up in volume in the base of the vacuum tower, it is removed continuously by a Dean Brothers eight by six by 12-inch hot oil pump. These pumps were equipped with a water

(*Continued on page* 98)

Application of Vacuum Distillation in the Refinery

IN general, high vacuum distillation in the refinery may be employed in three different operations—first, for the reduction of the heavy ends of a crude; second, for the re-distillation of cracked naphtha and kerosene fractions; and third, for flash distillation of very heavy bottoms from shell still operation. In each process, the principal effect of the use of vacuum is the reduction of the boiling ranges of the fractions being distilled. This is advantageous in various ways, not only from the mechanical side, but also with regard to improved quality of the products. Vacuum distillation makes possible the maximum recovery of overhead cuts, thus reducing the percentage of heavy fuel oil residues which are comparatively unprofitable.

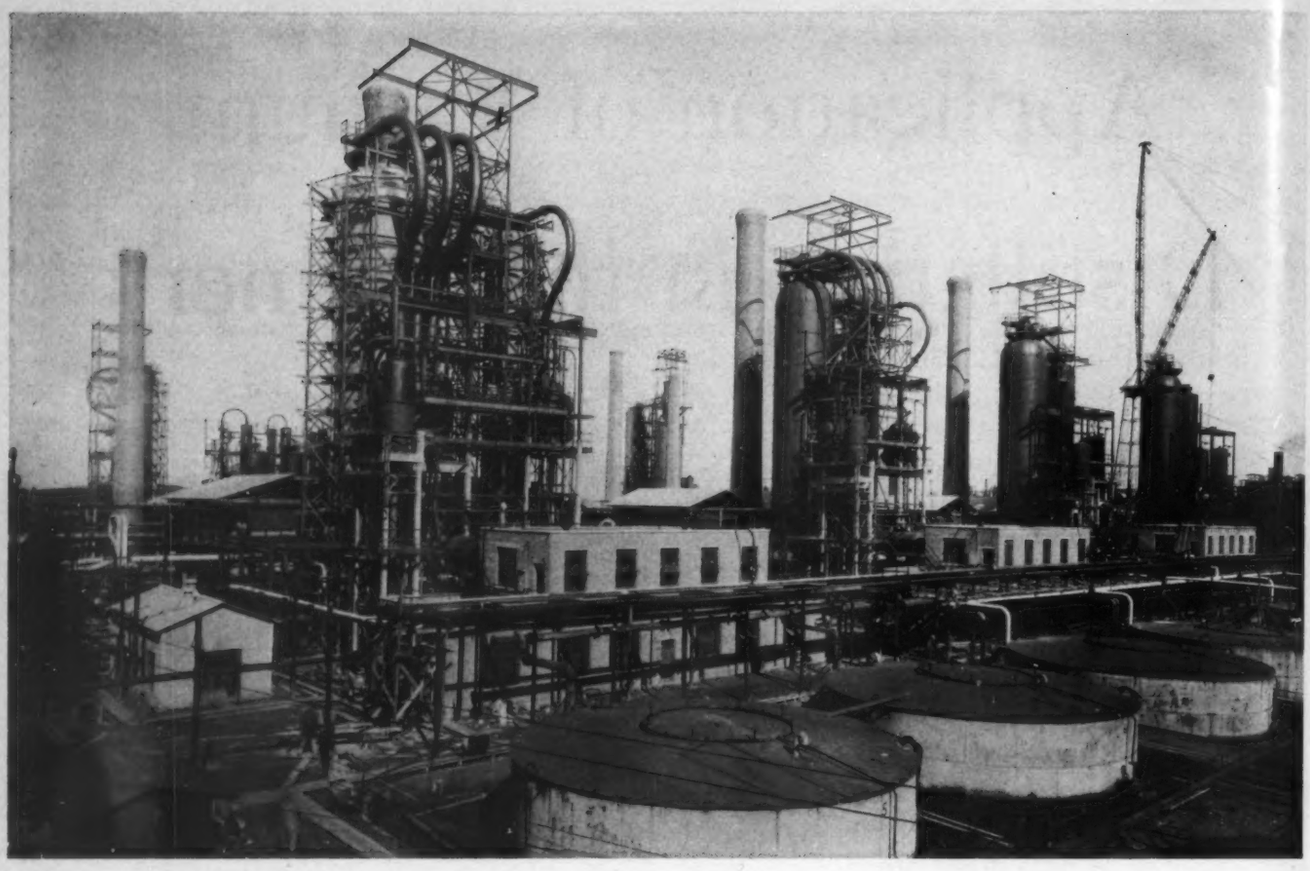
The application of high vacuum to crude being continuously distilled from shell stills makes it possible to reduce the crude economically to a lower per cent residuum than is generally practicable in atmospheric pressure distillation. In shell still operation, the deteriorating effect of hard firing upon both still bottoms and furnaces limits distillation of the heaviest portions of the crude. The average distilling temperature of a cut depends, of course, upon the pressure of the atmosphere or vapors above the boiling surface. If this pressure is lowered, then the oil boils at a lower average temperature. The use of modern steam ejector equipment makes it possible and commercially practicable to operate at absolute pressures in the region of three millimeters of mercury. At such low pressures boiling temperatures are much lower than what they would be at atmospheric pressure; and the injurious effects of hard firing on still and furnace are materially decreased. A direct result of this is that a greater total overhead may be taken from the crude. Heavy fractions which otherwise would go into comparatively unprofitable fuel oil are thus made available as a cracking stock of good quality or as paraffin distillate.

By reducing the boiling temperature of a given crude cut vacuum distillation decreases the degree of cracking. This is desirable, as cuts of better color are obtained. The difference may be enough to warrant including a cut which otherwise might, because of poor color, be thrown to gas oil, in the kerosene fraction.

Ordinarily, in the eight or 10 shell stills which compose a continuous crude distillation battery, the light products—naphtha and most of the burning oil—are taken off with only the aid of steam and without vacuum. The distillation units for these fractions consist of the usual shell still, a fractionating tower filled with bubble plates or packing, and a condensing coil of some type. Equipment for the succeeding vacuum stills is similar, with the exception that, due to less fractionation being required for the heavier oils, fewer bubble plates are used. From the first of the vacuum stills to the last, a regularly decreasing absolute pressure is maintained by the use of steam jet ejectors taking suction at the top of the fractionating towers. The crude enters the first of the atmospheric pressure stills and, flowing by gravity from one to the next, is stripped of the naphtha and burning oil by the time it reaches the vacuum stills. The oil then flows, because of the steadily decreasing absolute pressures, from one still to the next through the bottom flow lines connecting the stills in series. The vapors pass up into the base of the fractionating towers and rise to the top, where condensation occurs around coils through which circulates cold crude. The condensate falls back upon a collecting pan and is drawn off and cooled as distillate. It is advisable that the condensate be pumped into the cooler boxes, rather than be sucked through them, for in the latter case a leak in the cooler would cause the cooling water to be drawn into the hot oil, with dangerous results. The small quantity of noncondensable vapors and "leakage air" is sucked from the top of the tower and discharged, usually to an oil separator, with the water used by the ejectors. The percentage of non-condensable oil is small, though varying with the type of crude and with the rate of throughput. It should be usually around 1.0 per cent.

VACUUM BATTERY DESIGN

The design of a vacuum battery of this type calls for the balancing of heat and flow capacities at many points, in order that at various throughput rates the



World's Largest Battery of Distillation Units Producing High Grade Lubricating Stocks

percentage capacities utilized at each point may be approximately equal. There would be little gained, for example, in designing large towers that would accommodate a throughput of 30,000 barrels per day, if the size of the flow lines between the stills permitted a rate of only 15,000 barrels per day. It is true that, because of variations in the characteristics of different crudes, an exact design to produce at all times a close balancing of heat and flow capacities at various points in the system is impossible. Practically, the engineers will design, either on the basis of some crude which can be expected most of the time, or on the basis of an average crude representing the qualities of several predominant crudes in the refinery. In general, the mechanical design must embrace the following considerations: Carrying capacities of stills and crude charge lines; flow lines between stills; vapor condensers and coolers; towers (vapors); lines for circulating cold crude or water to produce reflux in the towers; pumps; and vacuum ejectors.

Thermal design must allow for adequate capacity of: Heat input to the stills; condensing capacity of the reflux-producing coils in the tops of the towers; and capacity of condensing and cooling coils for the streams.

If any of these capacities is so small that, at a given crude throughput when the others would be entirely adequate, this particular point is overloaded, then it may become the "neck of the bottle", limiting the charge rate. Or, if such limitation does not occur, very poor efficiency may develop at this point, resulting in loss or poor quality of product. For example, if in one of the vacuum towers the surface of the condensing coils is inadequate, an excessive vapor loss to the ejectors will occur. This may mean loss of vacuum as well as loss of oil.

The operation of the jet ejectors is sensitive. If, because of improper vapor condensation, a large volume of hot vapors reaches them, an increase in absolute pressure is likely to result. As partial protection against this contingency, small water-cooled tubular vapor coolers are often installed in the line between the ejector and the tower. Where spray steam is used in the still, a barometric condenser is necessary between the ejector and the tower to condense the steam. Improper operation of the barometric will cause faulty functioning of the ejector, which will be overloaded. All seams in the equipment should be welded to eliminate air leaks. Most ejectors are designed to operate with condensing water of a certain temperature, say 80°—90° F. A sufficient supply of suitable water must be maintained. Periodic testing of all ejectors by measuring the change in vacuum with varying amounts of air handled is advisable. Curves drawn from the date

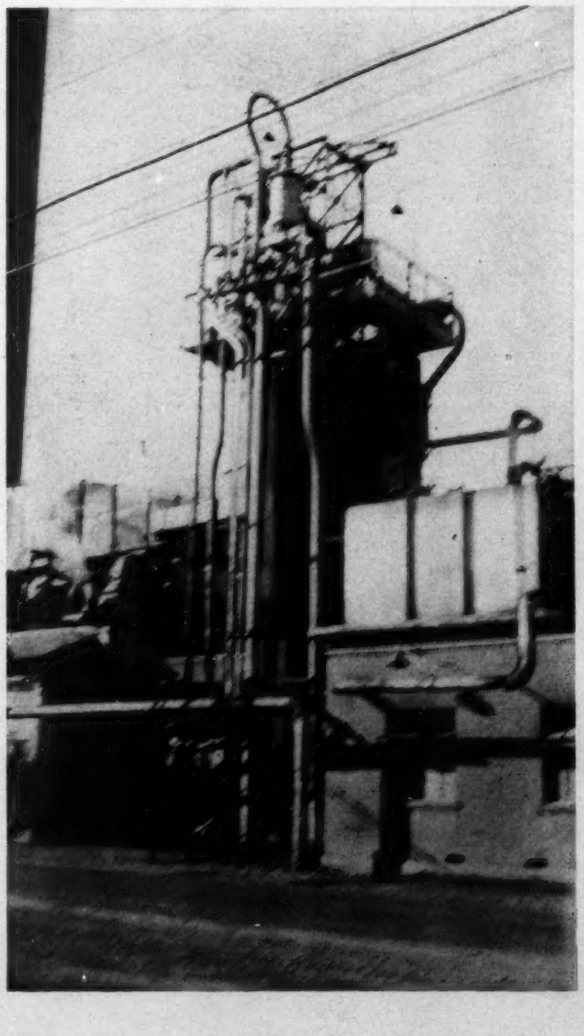
obtained should then be checked against the guarantee curves.

CRACKED NAPHTHA

A second phase of vacuum distillation has to do with the re-running of acid treated burning oil and cracked naphtha cuts. If these fractions are re-distilled under atmospheric pressure, it is found that the temperature of distillation is usually high enough to result in decomposition of the sulfur compounds in the oils. To prevent this, and the attendant poor colors and high sulfur contents, vacuum re-running is utilized. Here again, the boiling temperatures are materially decreased from what they would be in atmospheric distillation.

As the temperatures encountered are much lower than those of crude distillation, steam heat obtained from closed steam coils is frequently employed. The use of steam also gives closer control than can be obtained with gas or oil firing. Since the boiling range of the burning oil or cracked naphtha being re-run, is comparatively small, only two or three stills are required—unless, of course, a multi-stream fractionator tower is used. Several shell stills have the advantage of flexibility, where the quality requirements for the distillate change considerably, or where the nature of the charge is variable.

Each distillation unit consists of the still, the fractionating tower, and the condensing equipment. The vacuum ejector, which is similar to that used in crude vacuum distillation, may take suction at the top of the tower, causing the up-rising vapors to rise and condense against a cooling coil and then fall back upon a collecting pan. However, due to the volatility of the vapors encountered in such re-running, this porcedure would result in a large loss of uncondensed oil into the ejector. To avoid this, the usual practice is to take suction upon the vapor condenser, thus drawing the vapors from the tower directly across the tubes. The charge to such a system of stills may flow from one to the other still in series, successively heavier cuts being taken from each; or it may enter each in parallel. The choice depends upon the nature of the oil and upon what products are wanted.



In the case of series operation it is necessary to maintain successively decreasing absolute pressures down the line, or a difference in liquid levels, so that flow from still to still may be effected. With properly selected ejectors, absolute pressure as low as 0.5 inch mercury may be obtained when charging a re-run distillate of 35 to 40 A. P. I. gravity. In order to guard against temporary failure of an ejector, it is advisable to install a spare which is manifolded to all the stills.

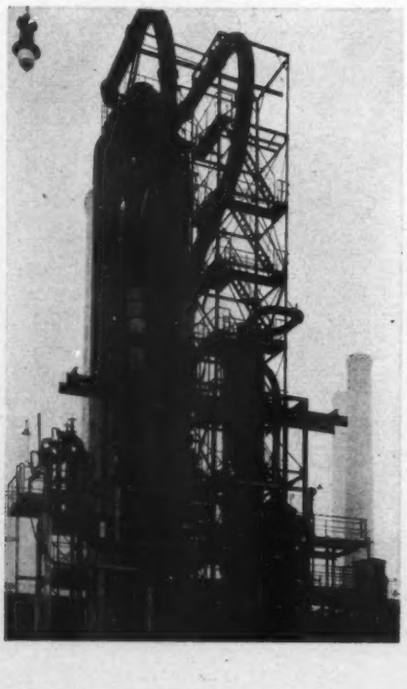
It is customary, where the burning oil or cracked naphtha cut is to be re-run in such a system, to take off a five or 10 per cent greater volume of these stocks from crude battery or cracking unit than would be otherwise required. This is done to allow the necessary "bottoms" to remain in the vacuum distillation after the specification products have been taken off overhead. Such bottoms constitute a good grade of diesel. The distillates obtained have a high water white color and are low in sulfur.

TUBE STILLS

The third phase of vacuum operation is single or double flash distillation from pipe stills. The recovery of heavy cylinder stock available in a crude is limited, in the case of shell still practice, by cracking in the still. The degree of cracking is, of course, affected by the temperature and the time of contact of oil in the heating zone. Time of contact in the ordinary shell still is long, usually eight to 12 hours. The taking off of cuts sufficiently heavy for cylinder stock is therefore ordinarily accompanied by cracking, which seriously reduces the flash on the overhead. Aside from this undesirable feature, the heat transmission rate at shell still bottoms is so low that to distil very heavy cuts imposes a bad localized heating effect upon the equipment. These two facts — cracking and the necessity for hard firing —are largely eliminated by pipe still vacuum flash distillation of a comparatively high per cent residuum from a continuous battery

or other topping unit. The pipe still, by affording a high velocity to oil in the heating zone, has a comparatively high heat transfer rate. As a result, the equipment is not as subject as are shell stills to the damaging effect of firing. Moreover, the short time of contact of oil in the heating zone reduces cracking to a negligible figure, thus making possible the recovery of a high flash, high viscosity cylinder stock from a crude residuum which might otherwise have to be disposed of as cheap fuel oil.

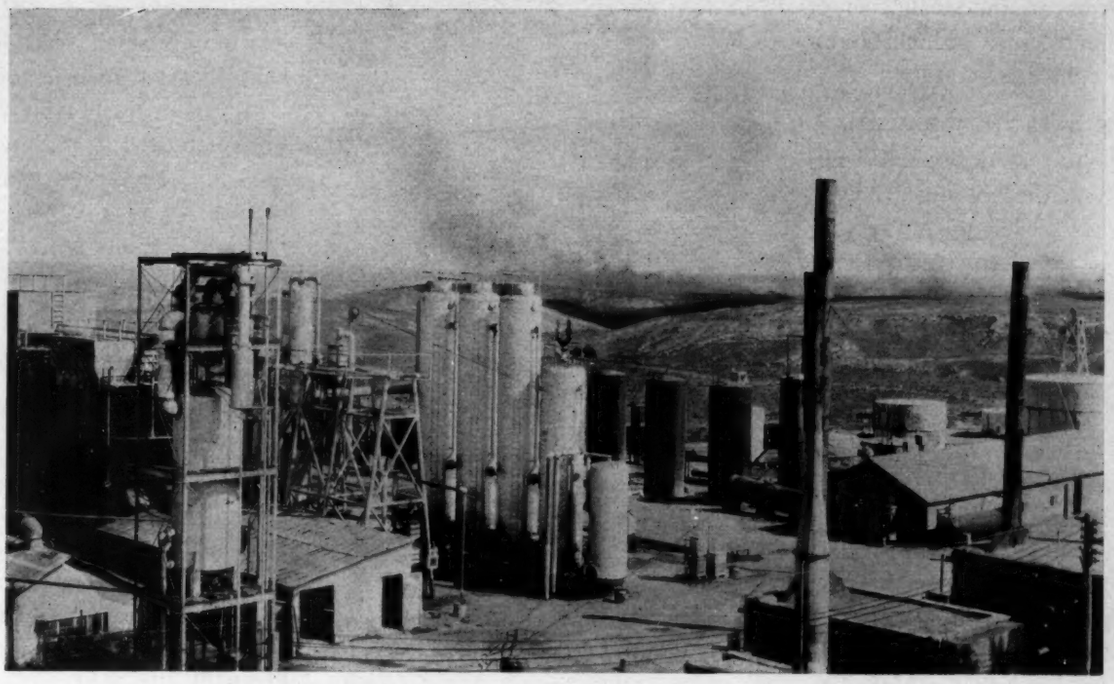
Flash distillation is achieved at comparatively low temperatures by maintaining a low absolute pressure of 0.5 to 1.0 inch mercury in the fractionating tower into which the hot oil-vapor mixture from the pipe still discharges. At temperatures of 700° to 800° F., a large volume of 140 to 200 seconds viscosity stock flashes off, under this pressure from the incoming charge—a distillation which would not occur at the same temperatures at atmospheric pressure. The ejector takes suction upon the vapor condensing equipment, which is in most cases of the tubular type. The lightest vapors thus rise up through the bubble plates in the tower and are drawn over through the condenser, where the condensate is pumped off. It frequently happens that a single stream produced in this manner is undesirably low in viscosity and flash. The majority of commercial flash towers therefore have one or more intermediate collecting pans, where much heavier grades of oil can be obtained. Part of the overhead is pumped back as reflux upon the bubble plate at the top of the tower. The exchange of heat due to the vaporization of this pump-back effects the condensation of a heavier grade of oil, which then overflows back through the tower upon the uppermost collecting pan. Part of this stream is returned to a bubble plate above the lower pan, thus causing a still heavier oil to be condensed and returned to the latter. To produce reflux for fractionating the vapors below the lower pan, part of its condensate is pumped back upon the bubble plate immediately beneath it.



In conjunction with vacuum, spray steam is often used to aid in taking over the heavier fractions. This is usually introduced into the base of the tower, where its effect is to redistil the bottoms; or upon the collecing pans, where the effect is similar. With spray steam a barometric condenser is installed between the tower and the ejector in order to condense the large volume of steam employed. The tower must be of large enough cross-section to keep the vapor velocities low enough to prevent mechanical entrainment of droplets from plate to plate. When steam is used, the vapor rate is, of course, much more than it would be in the case of dry distillation. Where paraffin-bearing residuum is charged, most of the paraffin will pass as vapor into the condenser. In order to avoid "freezing" of the wax here, it is necessary to keep the cooling medium at a rate low enough to insure constant liquefaction of the paraffin in the condensate.

By varying the amount of wash or reflux pumped back to the bubble plates, and the volume of steam used, widely different qualities of streams may be obtained. The paraffin-bearing light condensate is often satisfactory for use as paraffin distillate. Where the condition of the crystals is not acceptable, this cut may be utilized as cracking stock. The heavy residuum from the flash tower is constantly pumped off, and after being fluxed with a lighter oil is sent to fuel oil storage.

The pipe still used with this system is similar to the type used widely in cracking operations—a bank of tubes in the radiant heat section and another set in the convection heat section at the rear of the setting. If large tubes are used, series flow of the oil may be used throughout. Such flow is advantageous from the standpoint of the heat transfer coefficients realized with high oil velocities. Coking is also less than it would be with parallel flow of oil. Since time of contact, as well as temperature is a factor in cracking, temperatures over 800° F. can be maintained at the high oil velocities encountered.



Plant of MacMillan Petroleum Corporation, Borger, Texas

Vacuum Equipment for Gas Oil Production

CHANGING over from a crude charge in which Hutchinson County oil had been processed, Macmillan Petroleum Corporation, at its Borger, Texas, refinery, has made some important changes in the distillation and fractionating equipment. Hutchinson County crude, and especially that produced in and around the town of Borger, contains considerable salt and hydrogen sulfide. With Gray County oil being delivered to the plant, together with the new and rearranged equipment, processes have been simplified.

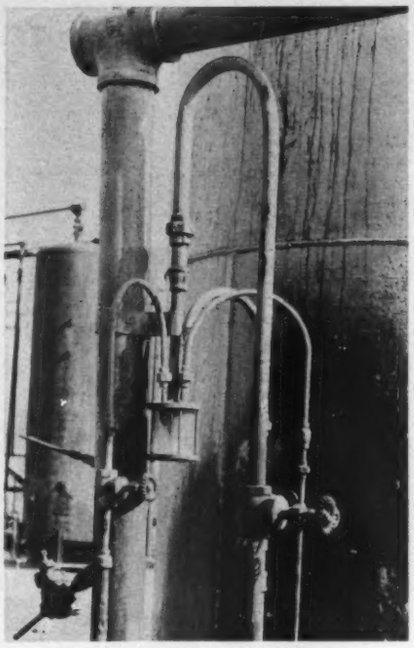
A series of fractionating columns with water cooled reflux condensers built above them were included in the original equipment. The oil was heated first in a series of interchangers to pass through hot water washing scrubbers to remove the saline content. Leaving the scrubbers, the crude charge entered one of the tube stills where a temperature sufficient to flash from it a small fraction of the gasoline vapors was applied. In this flashing chamber, the salt was settled from the oil due to precipitation to the base where it could be removed as found necessary. The flow led back to the other retort for final heating to remove remainder of the required fractions. (Ref. & N. G. M., June, 1929, Page 77).

In the present equipment, the oil is received from the pipe line delivering it from Gray County into four, 3000 barrel receiving tanks set in the corner of the plant yard. Near them, in a separate building from the other pumps is placed the Byron-Jackson two-stage centrifugal which delivers the oil to the preheaters. These are longitudinal sections fabricated from two- and four-inch pipe with packing glands utilized in such manner that expansion and contraction is prevented from causing leaks. Two of these are in service, being operated in parallel. Leaving these exchangers, the oil is led to the original horizontal settling drum remaining from the older equip-

ment. The temperature applied in the exchangers is sufficient to effect settling of the small amount of salt and other sediment contained in the oil.

PIPE STILL OPERATION

After passing through the settling drum, the oil under 260 to 270° F. is picked up by another Byron Jackson centrifugal pump, discharged through a float controlled valve placed on the discharge line outside the pump house. The float is attached to the settling drum and regulates the amount of fluid being handled through the plant. Leaving the pump, the oil flows to both the pipe still retorts placed in parallel. The connections in the charging line are so arranged that either of them may be left in service while repairs are being made. They may also be operated in series by having the oil delivered directly from one to the other. However that arrangement has not been placed in operation, the operation of them having been found to give the best results by passing the oil in a split stream through both in parallel.



Second stage of caustic injection in gasoline stream, MacMillan Petroleum Corporation.

Both of these retorts are of the same approximate dimensions, but one contains more tubes than the other. The first one built had 44, four-inch tubes 22 feet overall, while the other, built later, has 84, four-inch tubes the same length as those in the first still. Ordinary pipe line tubes are installed with the lap or butt weld placed uppermost away from the heat. This class of tubes have been found to give good results and have a life that is quite satisfactory. Both the retorts have dutch ovens for the combustion chambers placed partly below the surface of the ground. The flames from the burning fuel oil impinging on the walls of the ovens, permitting the tubes to receive the radiant heat, rather than that of convection. A temperature of 550° F. is maintained on the oil leaving the outlet of the tube banks by the regulation of the amount of fuel fed to the burners. Automatic recorder controllers are placed in the open a short distance from the still settings. The circulation of the fuel being effected by pumping against sufficient pressure to insure atomizing, while that not needed at the burners is returned to the supply tank.

The oil is led from the retorts through an underground line from each to converge in a common transmission line connected to the flashing or stripping tower. This tower as well as the following three fractionators were designed by the company engineers and have special plates incorporated in them. Entering the stripper column, the oil, having lost only a small fraction of the heat imparted to it in the retorts, is reduced to fuel by the assistance of superheated steam injected into the body of it near the base of the column.

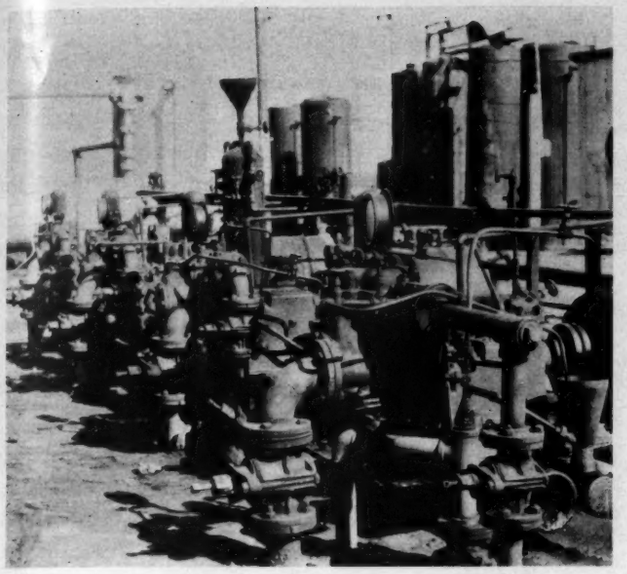
Steam for this purpose, as well as the application of it in the other towers, is led from the boilers to the retort having the smaller number of tubes. The steam is superheated there through a series of two-inch pipes placed under the bank of oil heating tubes. Furnace temperatures are such that this may be accomplished without detracting from the efficiency of the retort bank. Led from this retort, the steam is controlled by manually operated control valves placed in the line near the entrance to the towers. As it is admitted to the body of oil in the stripper, the steam is maintained at an average of 325° F.

VACUUM TOWER

As all of the vapors of the various fractions contained in the original oil are removed in the stripper, they are carried overhead, leaving to enter the side of the first fractionator in a series of three placed beside the stripper column. Fuel oil is removed from the base of the stripper, the level of which is maintained through utilization of a Fisher float and control valve. The process pressure of 15/20 pounds is sufficient to evacuate the tower of this residuum.

After being stripped of the various fractions, the fuel oil contains a certain amount of recoverable gas oil, and is sent to the vacuum tower for final treatment. Underground lines lead from the stripper outlet to this unit, being insulated in order that the heat of process is retained as much as possible. The vacuum unit, of Southwestern design, with Southwestern tubular enclosed condensers and Elliott vacuum producing equipment, was placed in operation with the idea of recovering more gas oil from the crude than could be distilled otherwise without the application of heat to the oil in the retort tubes approaching cracking temperatures. The low temperature is maintained in the retorts to avoid the possibility of coking the tubes.

The vacuum tower, a short chamber set in a steel framework, receives the hot residuum directly from the stripper column. Admitted to the chamber through an insulated line, it enters at a point about three feet from the upper end. Flowing downward over the plates it is acted upon by a vacuum averag-



Reflux pumps in MacMillan Petroleum Corporation, Borger plant.

ing around 24 inches hg. As it comes into the base of the chamber, superheated steam is admitted to the mass through a connection placed in the opposite side of the shell about two feet from the base. The action of the vacuum assisted by the superheated steam drives out of the fuel the remaining gas oil. Approximately five per cent of the original crude charge is recovered with this equipment as gas oil.

These gas oil vapors rise through the length of the tower against the descending fuel as it comes into the shell of the chamber. Leaving from the opposite side from the entry of the fuel, the vapors pass through an insulated line to enter a receiving box placed above the vacuum chamber. The purpose of this box is to receive the fractions of the fuel carried over and to return them to the tower below. Coming out of this apparatus at the top, the gas oil vapors enter a tubular condenser placed on one side of it. The liquid condensed in this water cooled condenser accumulates in a receiver supported outside the steel framework of the tower. A two-inch line leads to the ground, connected to a pump which removes the condensate as it accumulates. Those uncondensed vapors passing through the first condenser, pass upward and overhead to another tubular condenser placed on the opposite side from the first. The remainder of the gas oil and water vapors coming from the superheated steam are condensed to enter a receiver, a duplicate of the first one, where the liquid is caught before dropping down through a two-inch line connected at the pump suction with the line from the first receiver. As both lines carry the same absolute pressure, no danger is present which would permit the condensate form one to be drawn back into the other.

The line leading to the vacuum producing equipment is flanged to the upper side of the second condenser, through which a vacuum is imparted in series through the condensers to the body of the oil in the chamber. To the other end of the flanged line are placed the Elliott jets and air pumps operated by steam from the boilers. Condensing water is pumped from the louver tower to these vacuum heads to reduce the steam to water, assisting in maintaining the required vacuum on the chamber. Excess steam not condensed through the action of the jets and barometric column is led upward to the atmosphere through two two-inch risers.

The stripped fuel oil having a gravity of 25/27 degrees API, is removed from the base of the vacuum chamber by a suitable pump, delivering it back through the heat exchangers in counter-current to the fresh crude charged to the retorts. Cooled to a temperature of around 140° F., the fuel is placed in storage before being burned in the boilers and retorts, or loaded from the 30-car rack built near the plant on a spur from the Santa Fe railroad.

FRACTIONATING TOWER PROCESS

The vapors from the stripper tower in the fractionating unit enter the gas oil tower where the lighter vapors rise upward in contact with the reflux. A temperature of 500/510° F. is maintained overhead, permitting everything lighter than the first gas oil cut to pass through an overhead line to the next tower. The fractionated gas oil is removed from the base of the tower through a Fisher float controlled valve to flow through coolers to storage. As this cut is condensed, a portion of it is circulated back over the stripper tower to prevent heavy fuel from coming overhead with the fractions driven from the crude charge there.

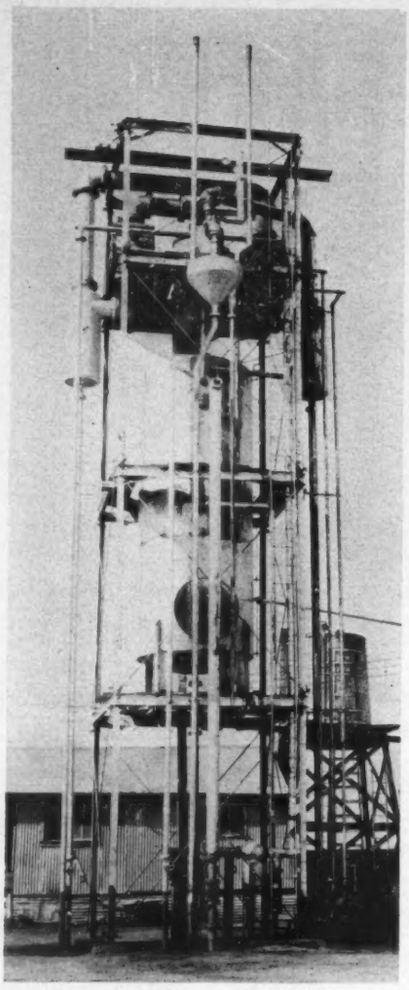
The next tower in the series fractionates a similar cut of gas oil. However, when the market is right and the demand is sufficient, the cut from the base of this tower is fractionated to a mineral seal product. If the demand for that product is not sufficient for continual processing, the stream from the base is

Pump house in the refinery of MacMillan Petroleum Corporation, Borger, Texas.

placed in the same storage after being condensed in a separate section. The top temperature of the second fractionator is maintained by refluxing kerosene from the base of the third tower in the series.

Vapors leaving the second tower contain all the gasoline from the crude as well as the kerosene. The temperature of the top of the last tower is maintained at 328/30° F. by refluxing with gasoline from the second gasoline receiving tank. Kerosene is removed from the base, while the gasoline vapors are taken from the overhead stream.

Gasoline vapors leaving the top of the last tower are carried over to a drum in the line through which they pass to the eight-inch vapor line leading to the primary condensers. Here they may be converted as plant practice requires. If the demand requires that a high gravity export grade be removed from the vapors, the primary condensation is removed for motor fuel blending stock, while the remainder is carried over through the secondary condensers for the required fractions. Normally the entire stream is carried through both the primary and secondary condensers to furnish motor fuel without the necessity of blending to any great extent.



Vacuum unit in which hot bottoms from stripping tower are processed to recover additional gas oil.

VAPORS GET CAUSTIC WASH

In the line as the vapors leave the fractionating tower, the gasoline vapors receive a stream of 10/12 degree caustic. This is blown by air pressure directly into the stream to create partial alkalinity to the vapors. Further down the eight-inch line, but before it enters the eight Griscom-Russell Bentube sections, is placed a Swartfout separator for the removal of the caustic which may settle out in the line. This is brought down through a two-inch cast iron line to a settling drum to be drained away to the sewer as it accumulates.

After leaving the primary condensers, placed in the top of the louver tower, the gasoline vapors and partially condensed gasoline pass through a six-inch line where another Swartwout separator is placed to remove the water and remaining caustic before the vapors enter the secondary condensers. Two banks of Southwestern enclosed tubular sections are placed in parallel, the stream splitting to flow through the banks in this manner for final condensation.

As the gasoline is condensed, it is received in a vertical accumulator tank where just before entry into it, it is given the second contact with caustic. This is sprayed into the line leading into the accumulator through a sight feed apparatus through which the strength of the caustic may be regulated at the will of the operator. Instead of changing the gravity of the treating solution in the supply tank, it is diluted to that required by a stream of water injected into the sight feed receiver. Air under sufficient pressure is blown into the glass bowl of the caustic feed to drive the solution into the line leading to the accumulator tank.

Passing from this vertical receiver, the gasoline is led to a secondary accumulator placed in a horizontal position on cement piers. The gasoline is removed from the opposite end to that of entry into the tank, while a second line is placed overhead by which the vapors are removed. The reflux for the last tower is pumped from this horizontal tank, and the overhead line is designed to prevent the reflux pump from becoming gas bound.

The reflux circuit is placed so that the first tower in the fractionating equipment receives reflux from the next highest gravity product recovered. That pumped to the stripper tower being gas oil; the gas oil tower having mineral seal or the highest gravity gas oil pumped over it. The mineral seal tower receives kerosene, and the kerosene tower having gasoline pumped back for reflux.

Kerosene and gasoline are both treated in the plant continuous treater, the method of which has been described on Page 77 of Refiner and Natural Gasoline Manufacturer of June, 1929.

Through processing 6500 barrels of oil through this equipment, the cuts from the various phases of operation are as follows—Gasoline—U. S. motor—40 per cent. Kerosene, 6.5 per cent. Gas oil and mineral seal, 15 per cent. Ten per cent is recovered through the normal fractionating equipment, while the additional five per cent is recovered through the vacuum processing equipment operating on hot fuel from the stripping tower. Fuel oil remaining represents 37 per cent of the original charge, with the plant loss, including processing and treating represents the remaining 1.5 per cent.

Asphalt by Vacuum Distillation

AFTER having operated the refinery on the various grades of Southern Arkansas heavy asphaltic crude oils, from which a high octane number of gasoline is obtained, Lion Oil Refining Company installed and operated a number of small laboratory experimental units leading to the production of asphalt products by the distillation of the oil under a vacuum. The products previously obtained by the distillation of this heavy oil in shell stills with steam at atmosphere, the distillation under pressure and higher temperatures, left a residuum that was not quite satisfactory in quality. Consequently they have erected and placed in operation at El Dorado the largest complete skimming and reduction plant in that territory utilizing vacuum as the means by which all the naphtha, gas oil light and heavy lubes can be removed from the asphalt flux.

The Smackover crude that is processed through this equipment varies from 18 to 21 degrees API gravity with a naphtha content of approximately 11½ per cent, coming from the vapor condensers with a gravity of 47 degrees API, an initial of 164° F. and a 50 per cent point of 320° F., recovering 98 per cent at 420° F. The naphtha recovered has an octane number of 74, doctor and corrosion negative with a simple treatment with caustic in the line leading from the condensers to the accumulator tank.

Gas oil recovered equals approximately 28½ per cent of the crude charge, having a gravity of 27.4 API, a flash and fire of 225 and 260 respectively. It has a viscosity of 47 at 100 (SU), pouring at —45° F., with a light straw color. The naphtha and gas oil vary only slightly in percentages recovered, regardless of the grade of asphalt flux removed from the vacuum tower.

The crude has a bs&w content of about two per cent, which is removed before it enters the vacuum chamber of the large tower. The geater amount of water is removed in the field, either at the wells or at the central lease batteries.

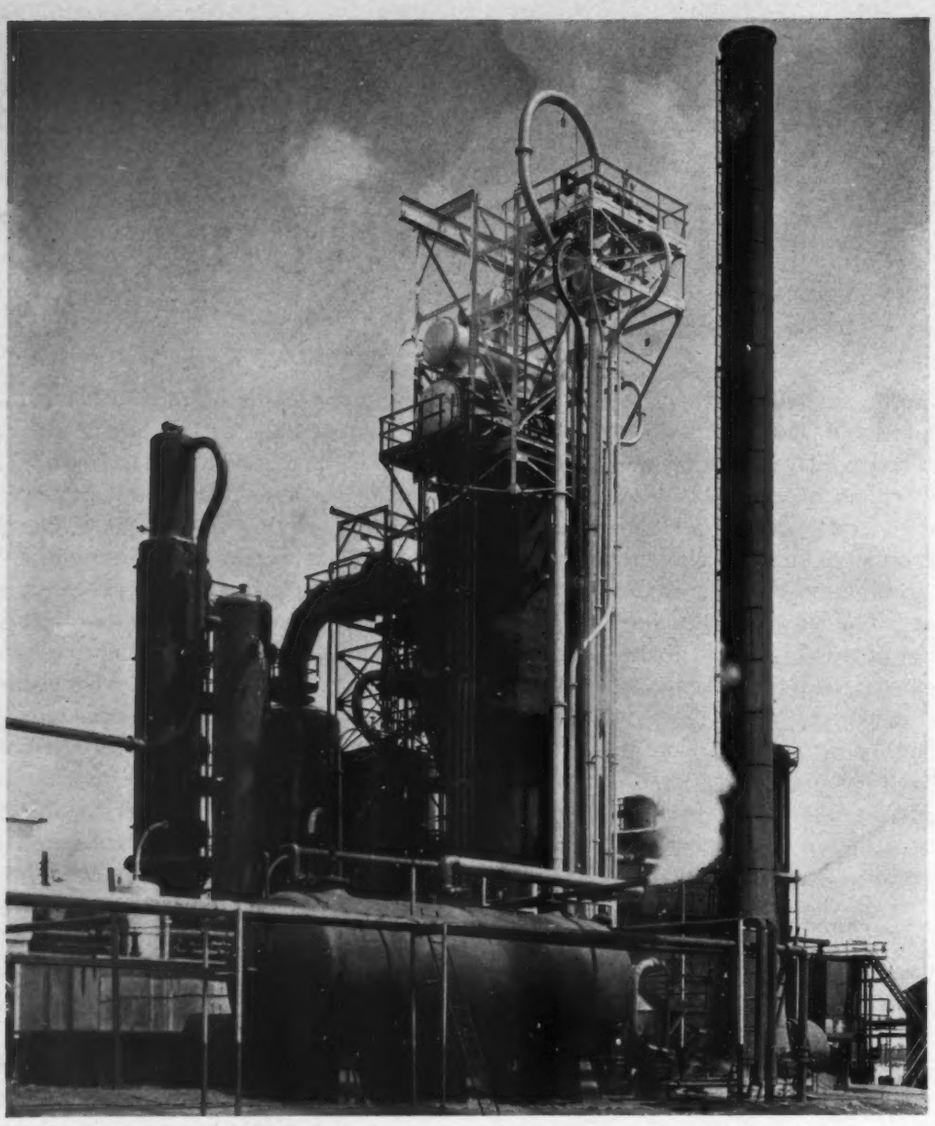
VACUUM UNIT

The equipment in the refinery used in the vacuum process centers around a pipe still and the two vacuum towers. The larger tower is used in the reduction of the oil after it has been skimmed of the naphtha and gas oil. This tower is 17 feet inside diameter at the point of flash, 47 feet nine inches from the cement base to the top of the constricted neck. On the top of the tower are two openings four feet in diameter upon which is installed a heat exchanger condenser having 4000 square feet of effective exchanger surface in the tube bundle. On top of this exchanger is a smaller one, connected directly to the larger by two openings three feet in diameter. It has 2000 square feet of effective cooling surface.

Directly on the single outlet leading from the top of this condenser, the vacuum equipment is flanged in a horizontal position with the steam connections in one end and the barometric condenser at the other, supported by a superstructure of steel extending from the supporting steel frame surrounding the top of the tower and condensers. This vacuum equipment is in three stages; the first being termed the booster, while the others are called the air pumps. From the head of this equipment is placed a 16 inch barometric column, with the lower opening placed in a cement box where the water and condensed steam can drain back to the water pond. Entering the top of the barometric condenser is a twelve inch water line serving to condense the steam and assist in pulling the vacuum required. The condensers, exchangers and vacuum equipment on the large tower are Elliott type.

Following the crude charge through the process, it is first picked up from the plant storage tanks in which it is received from the pipe line, to be subjected to one of the two preliminary treatments; the first of which may be used to remove the entrained water by heating in a pair of furnaces to a point where the water may be separated by settling in tankage, or through the second process by passing through these furnaces to a temperature of approximately that of the boiling point of water. It is then flashed in to the smaller vacuum tower, made from one of the old Burton stills which had been taken from service. This tower is equipped with an Elliott ejector similar to the large one. The water is removed in the stage between vapor and steam which carries with it some of the light naphtha fractions, which are separated continuously in a tank set for this purpose.

As the water is taken off overhead in this tower the bottoms are free from moisture and are pumped through the larger of the two exchangers on the top



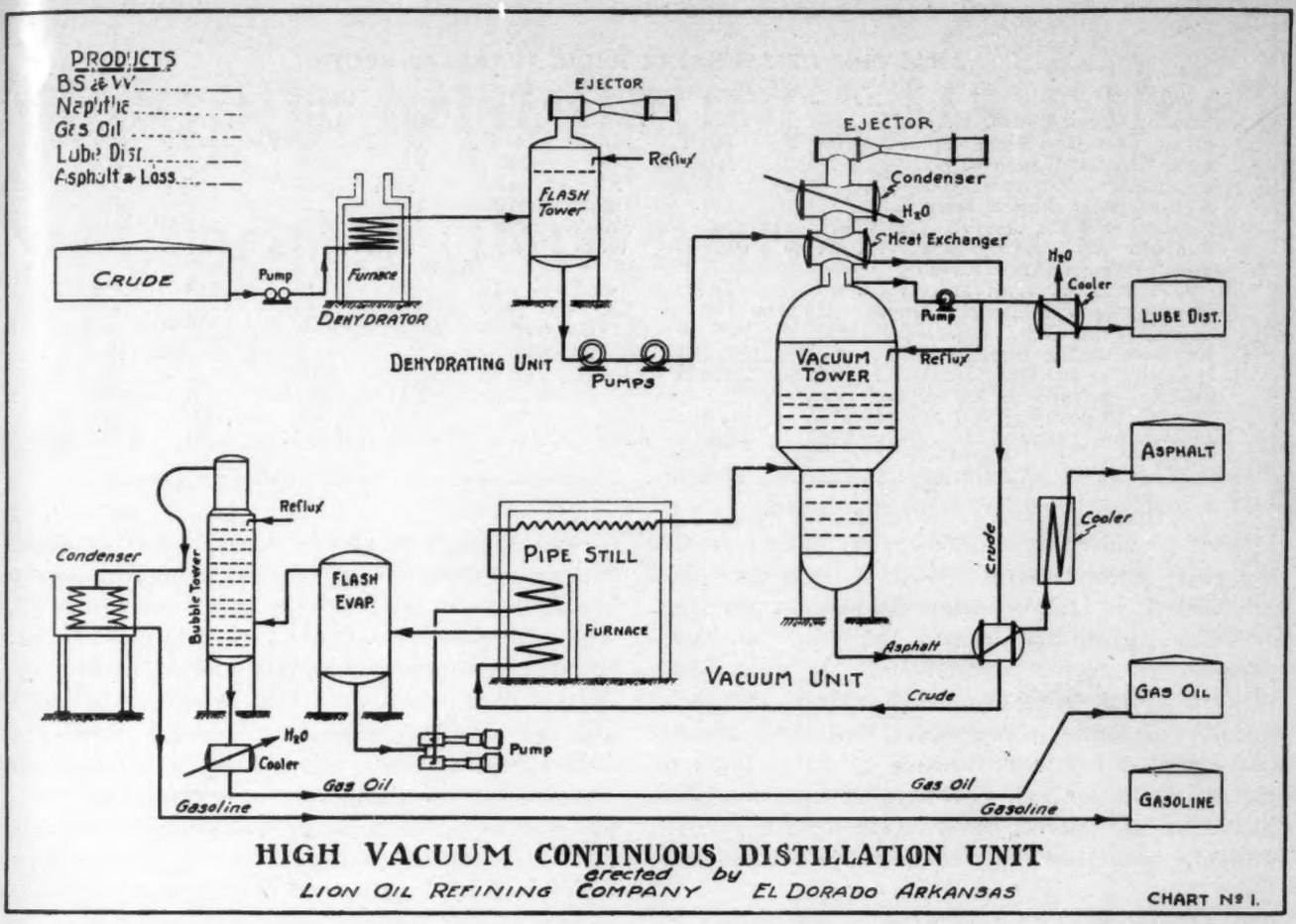
Lion Oil Refining Company's Vacuum Plant, El Dorado, Arkansas

of the vacuum tower, acting as a trimming coil to condense the overhead cut taken there. Travelling downward beside the structure, the crude is led through a Southwestern exchanger in counter flow to the reduced asphalt material from the base of the vacuum tower. After passing through this apparatus, it is placed in a surge tank, ten by thirty feet, insulated to conserve the heat imparted to it by passing through the previous exchangers. Picked up there by a National Transit duplex steam pump, it is sent directly to the lower bank of tubes in the pipe still where a temperature of 670° is imparted to it. Transferred to an evaporating flash tower, the crude is stripped of its naphtha and gas oil content by the assistance of superheated steam.

LIGHTER PRODUCTS

Both the naphtha and gas oil vapors are taken from this stripper to be led into the fractionating bubble tower. Naphtha cut in an overhead stream, controlled as to end point by refluxing with the product, is condensed in a battery of submerged sections placed in a box on the roof of the control room. Separation of the water and gasoline is effected in a vertical accumulator tank, the gasoline, or naphtha, being removed from a connection in the top of the tank through a pipe leading into the ground, in which is placed a Joseph Reid look box, through which it flows to storage. Material for the refluxing of the bubble tower is picked up from this accumulator tank by one of two Byron Jackson type 1x6 ER 25 gpm, centrifugal pumps operated through direct drive by a Coppus 12 hp. steam turbine.

The gas oil fraction is removed directly from the base of the bubble tower in an accumulator tank similar to the naphtha receiver, but previously cooled in a water controlled Southwestern two-section tubular condenser. The bottoms from the secondary flash tower, being freed of the lighter fractions, are removed by a Wilson Snyder compound reciprocating pump, size 22 by 36⅛ by seven by 24 inches. Connections are placed in the steam transfer line



HIGH VACUUM CONTINUOUS DISTILLATION UNIT

erected by

LION OIL REFINING COMPANY EL DORADO ARKANSAS

CHART Nº 1.

from the high pressure cylinder to the low by which live steam under boiler pressure may be admitted to the low pressure cylinder if needed. Exhaust steam from this pump is led through superheating coils in the pipe still furnace for agitation in the several towers and strippers.

ASPHALT FROM VACUUM TOWER

From this pump, the oil is directed to the upper bank of tubes as well as the roof bank by which a temperature of 700° F. is imparted to the charge before it is transferred directly to the large vacuum tower to enter above the stripper plates in the smaller section of it. Especial attention is focussed on this part of the process by which the principal product of the plant is manufactured. Depending upon the grade of the asphalt produced, the process is controlled by the rate of flow through the tower, the vacuum applied and the amount of reflux pumped back over the top plates of the large part of the tower near the top as well as the temperature of the reflux condenser. This is controlled by passing more or less water through the tubes of the smaller of the two exchangers on top of the tower. However, a temperature is maintained on the top of the tower low enough that nothing is removed from it but fixed gasses and air by the ejector or vacuum equipment.

In all cases a cut of light lubricating distillate is taken from the constricted neck at the extreme top of the tower, just under the two four-foot outlets. In making a light bottom flux in the vacuum distillation equipment, this is the only cut removed from the upper section of the tower. It is removed by a single stage Byron Jackson 150 gpm. submerged head, centrifugal pump. This pump removal is essential for the reason that the vacuum of 50 to 60 millimeters absolute would hold the material upon the collector, and if not removed, the jet could pull it overhead with the fixed gasses. If the bottoms in the tower are being reduced to a heavier material, a secondary cut is taken from the side of the enlarged part of the tower. This is a varying weight lub distillate, in some operations resembling transmission oil or a heavy steam cylinder stock. This cut is removed through a reserve pump hung near the base of the tower which may be either operated on the overhead, the side cut or the bottoms from the tower itself. It is also a Byron Jackson motor driven unit, but has four stages with a capacity of 200 gallons per minute at 135 pounds. The lighter cut taken on the overhead stream when making an average asphalt residuum has a flash of 415, a viscosity of 735 (SU) @ 100, 66 @ 210, pouring at minus 20 degrees with an average gravity of 18.7 degrees API.

The product from the base of the tower, whether

ANALYSES OF ASPHALTS FROM ARKANSAS CRUDE

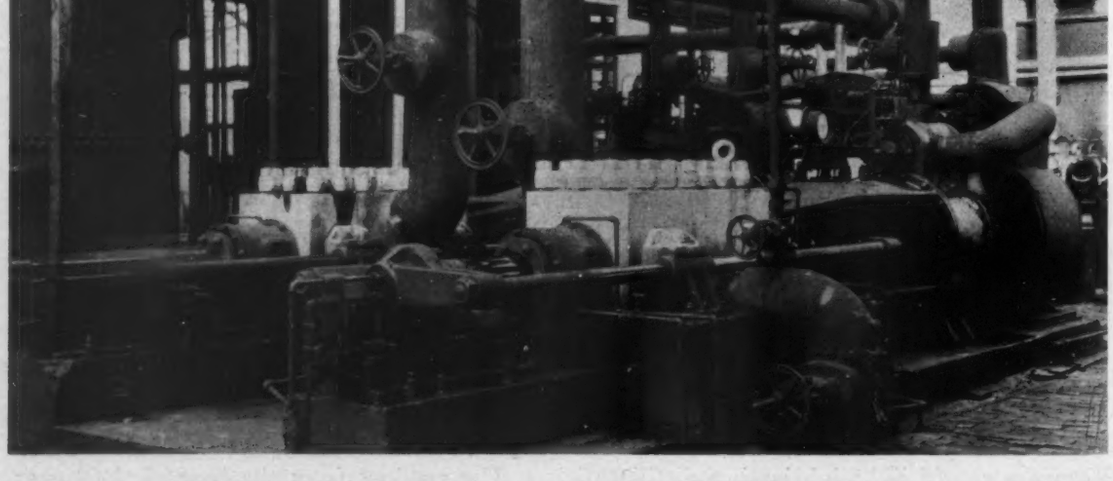
GRADE	30-40	40-50	50-60	60-70	85-100	100-150	150-200	220-260
Specific Gravity @ 60°F	1.038	1.036	1.032	1.030	1.024	1.022	1.018	1.014
Flash, Cleveland open cup	685°F	680°F	675°F	670°F	665°F	660°F	655°F	650°F
Fire, Cleveland open cup	755	750	745	740	735	735	725	720
Penetration, 100gms-77°F-5sec	34½	47	54	67	92½	135	172½	230
Melting point, Ball & Ring	137°F	130	126	120	116	111	107	103
Float @ 150°F.....150	526sec	366	312	238	189	150	131½	116
Evaporation loss, 50-5-325	0.1%	00.01%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Penetration of loss residue @ 77°F	31½	44	49½	63	84	112	160	198
Ductility @ 77°F. lcm per minute	150 plus	150	150	150	150	150	150	150
Solubility in CS2	99.75%	99.75%	99.75%	99.80%	99.80%	99.9 %	99.9 %	99.9 %
Bitumen soluble in CCl4	99.70%	99. 7%	99. 7%	99.7 %	99.75%	99.75%	99.75%	99.75%
Insoluble in 86° Be. Naphtha	22.75%	22.50%	22.45%	22.1 %	21.85%	20.75%	20.1 %	20.1 %
Specific Viscosity @ 302°F	43.2	35.5	30.5	29.4	22.3	19.7	15.8	14.0
Specific Viscosity @ 350°F	14.6	13.9	12.0	11.1	9.9	7.6	6.7	6.2
Pounds per gallon	8.647	8.629	8.596	8.578	8.529	8.512	8.480	8.445

finished or consisting of a flux ready to be placed in the shell converters for oxidation, is a controlled product. It is removed from the base by the third centrifugal pump built in with the unit. The pump proper takes suction directly from the mass ready to be removed, being flanged directly to the plates forming the outlet connection. This short coupled connection is necessary because of the vacuum on the mass and the high viscosity. If the pump were placed at any appreciable distance from the outlet, difficulty would be experienced in maintaining suction.

By operating with this vacuum equipment, the quality of the asphalt has been found to be superior to that manufactured in the atmospheric or pressure type of distillation apparatus, less fuel is necessary in the furnaces, and considerable steam saving is made by the vacuum process. The unit requires through the several condensers approximately 3000 gallons of water per minute. Gas consumption in the two furnaces has averaged approximately 500,000 cubic feet per day.

On a throughput of 6500 barrels of crude during 24 hours, 750 barrels of high octane number gasoline blending stocks are removed; 1800 barrels of gas oil, with a varying amount of lubricating oil distillates, centering around 2000 barrels, and an asphalt production of approximately 1750 barrels. The gas oil and lub distillate have been blended together to form a cracking stock utilized elsewhere in the plant. The unit is almost automatic in operation when once placed in equilibrium, only one man being necessary for the operation during each tour. Controls are maintained by Brown electric pyrometer controllers on every thing but the throughput pumps which are set and operated by manual control.

Lion Oil Refining Company's plant is managed by the following men: T. H. Barton, president; J. J. Allinson, manager refining division; J. B. Rogerson, chief engineer; J. L. LeBleu, plant superintendent; and W. M. Carney, chief chemist, and to these gentlemen we are grateful for permission to discuss in detail the features of construction and operation of this interesting vacuum unit.



Main charging pump to vacuum tower, Lion Oil Refining Company

Vacuum Distillation: Its Effect Upon Lubricating Stocks

By MAX B. MILLER*
President, Max B. Miller Company, Inc.

IN undertaking a discussion of the centrifugal dewaxing of heavy overhead stocks such as are produced for lubricant manufacture by means of vacuum distillation, it is assumed that everyone is sufficiently familiar with the centrifugal manufacture of bright stock and the dewaxing of long residuum so that no comment regarding these prior developments is necessary here.

There is one point, however, with regard to the handling of these residual stocks which should be mentioned, inasmuch as it has served as the principal impetus back of the later developments which have led to the use of vacuum distillation, and the consequent centrifugal dewaxing of the resultant distillates. The decolorization of the raw stocks from which lubricants are manufactured, is referred to. Of all the various steps which enter into the manufacture of finished lubricating oil, whether the product is manufactured from the handling of a residuum or an overhead, no one step is so expensive and so inconvenient as that of bringing the oil to final color.

In fact, the idea of producing the heavier stocks by virtue of bringing them overhead by means of vacuum distillation was fostered by the desire of concentrating asphaltic impurities in a still residue so that the overhead stocks could be brought to final color with less loss and less expense than had been the case where residues of similar character had formerly been treated.

Like most new developments, however, the use of vacuum stills for the production of heavy lubricating oils was at first applied in fields in which there was really no economic value. For instance, a number of units were installed in the Pennsylvania field in which it was the intention to produce overhead bright stocks. However, even though these installations were successful in operation so far as the production of pressable-wax distillates was concerned, and did produce an overhead stock which could be centrifugally dewaxed, the fact remained that the still bottoms resulting from the operation were of such a high percentage that the refiner could best run to a steam-refined stock residuum, filter the residual product thus reduced, dewax the filtered oil, and produce more value than could be effected if the heavier stock were taken overhead. In the handling of Pennsylvania oil, acid treating is not permissible, and the losses to still bottoms as a result of the vacuum-distillation procedure were far greater than those experienced where the residual stock was filtered to color. This being the case, the use of vacuum still for the production of heavy overhead lubricating oils is limited to the handling of mixed or asphalt-base crudes wherein, if similar oils were produced as a residuum, the loss from subsequent acid treating would be far in excess of that experienced where the overhead stock is produced instead.

In this particular field, however, it would seem that the production of heavy overhead stocks and the subsequent centrifugal dewaxing of them is most desirable for a number of reasons. In the first place, the cost of acid-treating residual stocks, to present lubricating-oil standards even from selected mixed-base crudes, is excessive. Sludge losses from the treatment of such stocks with very few exceptions will range from 35 per cent to 50 per cent of the stock so treated. The acid dosage required in the treatment of these stocks ranges from 30 to 60 pounds of acid per barrel. In the case of residual stocks from many of the mixed-base crudes the acid required for treatment and the consequent loss is such as to preclude the profitable manufacture of finished lubricating oil from them.

ACID REDUCED

By producing heavy overhead stocks by vacuum distillation, the quantity of acid required is reduced upon the average by 50 per cent, and the loss to sludge as a result of such treatment in many instances has been reduced by two-thirds. In addition to that, the use of the vacuum still in the production of these stocks eliminates the necessity of selecting, allocating, and handling selected crudes for the purpose, it being recognized in most instances at least, that with the vacuum still, an oil of first-rate quality can be produced from the pipe line run of paraffin-bearing or mixed-base crudes.

The economies resulting from the production of overhead stocks by vacuum distillation which are suitable

*Presented at the Petroleum Refining Meeting under the auspices of the petroleum division, and the Plainfield Section, Elizabeth, New Jersey, of the American Society of Mechanical Engineers.

for centrifugal dewaxing and lubricating-oil production are more than sufficient to warrant the procedure if this were the only result to be accomplished. However, in addition to these economies it would appear that the overhead stocks produced are of a better quality than would be possible in the case of producing an oil of similar viscosity from a residuum. The flash and fire test of the oil with relation to its viscosity is much higher, and the viscosity-temperature curve for the overhead stock is much flatter than in the case of a similar residual product.

When the idea of producing heavy overhead lubricants was first suggested, there was considerable doubt as to whether the resulting product could be successfully centrifugally dewaxed. It has been well known for some time past that the centrifugal process is not adapted to the handling of stocks containing waxes having a high degree of crystallinity; that the bringing of stocks overhead has a tenednecy to cause subsequent crystallization of wax in larger and lighter particles, and in consequence it was thought that even in the case of the heavier stocks so produced the wax resulting from subsequent chilling would interfere with the continuous operation of the centrifugal-dewaxing process.

There have, however, been improvements in vacuum distillation that have practically eliminated this objection. In the first place, the vacuum still has been brought to the point at which it is possible to cut so deeply into the crude that the heaviest wax and jelly-like fractions are vaporized, and, secondly, this may be done without sufficient cracking to destroy the amorphous nature of the precipitated wax.

TYPES OF VACUUM STILLS

It is desirable to produce overhead stocks suitable for centrifugal dewaxing not only in order that this manner of wax separation may be made available, but also for the reason that if the stock is so produced, it is certain that little, if any, cracking has taken place during the process of distillation, which is desirable not only with regard to the yield with relation to both the crude and the money invested in distillation apparatus, but also with respect to the characteristics of the finished product.

Producing overhead stocks by vacuum distillation which can be centrifugally dewaxed is not the simplest thing in the world. The success or failure of the entire procedure is controlled by the design of the vacuum still, and the manner in which it is operated.

To date most of the vacuum stills designed for this purpose have been of the single-pass, single-flash type, in which the topped crude is passed once through the coil and flashed to a fractionating column for subsequent fractionation. This operation is supplemented by the use of sufficient superheated steam fed at the base of the column to strip the residue and compensate for the temperature drop in the column due to vaporization. This type of still should be adequate for the purpose, provided (1) that the column incorporates a sufficient number of trays of sufficient area, and (2) that the temperature and volume of the superheated steam is sufficient to compensate for the temperature drop in the column. As a further advantage it is well to equip the tower with a side-stripping section in which steam can be used for the close stripping of the stock which is to be subsequently dewaxed, as such a procedure not only insures the product coming to specifications, but, in addition, eliminates the floating or crystalline waxes which usually occur in the lighter cuts, and which if allowed to remain, if they do not interfere with the cold test of the finished product, at least tend to cause a troublesome after-cloud.

Some time ago a fair-sized experimental distillation unit was erected with which a large variety of centrifugally dewaxable stocks were produced which differed somewhat from the single-flash type. In this unit two heaters were utilized. Topped crude was passed through the primary heater and to the column, as in the case of the single-flash system, except that the temperature utilized was kept somewhat lower so as not to crack the lighter fractions of the stock which were being sought. As a result of the lower temperature, less oil was taken overhead by the heat supplied by the primary heater, but such part of it as was not vaporized was picked up at the bottom of the column, reboiled through the secondary heater, which was run at higher temperatures, and discharged into the top of a stripping volume, to the bottom of which super heated steam was added. The vapors from the stripping column passed up through the fractionating column to assist in vaporizing the feed, and for supplying heat of vaporization.

REBOILING

The reboiling idea commends itself for several reasons: In the first place, by reboiling, better stripping of the bottoms is obtained, and it is thus possible to go further into the crude and secure the heavier fractions which are not as a rule produced with the single-flash system. Furthermore, by having the still equipped with a reboiling section, it is possible to utilize more reflux than would ordinarily be the case, and thus clean up to a larger degree the vapors which are subsequently condensed in the stock that the refiner is after. In the third place, the reboiling system permits lower temperatures in the primary still by which the lighter ends of the dewaxable distillate are vaporized. It is these lighter ends which contain the waxes which are difficult to centrifuge. By utilizing a low temperature for the vaporization of these lighter ends there is less danger of subsequently forming waxes too crystalline for centrifuge operation. The heavier ends of the stock will stand higher temperature without interfering with subsequent centrifugal operation and this, of course, can be taken care of by the secondary heater.

As far as the ability of the centrifuge to handle these overhead stocks is concerned, the reboiling idea is most

important from the point of view that it permits the refiner to go further into the crude. The waxes contained in these heavier fractions are more amorphous or, in other words, their crystals are smaller and represent what is called the real petroleum jelly. By virtue of bringing overhead these very heavy ends and the addition of these heavy amorphous waxes, it is possible to produce a much longer cut which can be centrifugally dewaxed than otherwise for the reason that the amorphous wax from the heavier stocks compensates for the crystalline wax in the lighter ends so that the conglomerate particles of wax formed by chilling can be more readily centrifuged. This can be best understood when it is pointed out that most of the plants utilizing vacuum stills for the production of overhead stocks have limited their centrifugal-dewaxing units to the handling of overhead bright stocks. In addition to that, most of them have blended this overhead stock on the basis of about 80 per cent overhead stock with 20 per cent of residual stock from which residual bright stock was formerly made. This procedure, it is claimed, is necessary so that the resulting product will have more body than is possible in the case of straight overhead. However, the blending of the residual stock adds petroleum jelly to the wax formation, and does assist in dewaxing though it is reported by most of those who are operating single-flash stills that as far as dewaxing is concerned, the procedure is not necessary as far as the production of overhead bright stock is concerned.

Nevertheless, with the experimental still it has been possible, not only, to produce overhead bright stock, but to go to long overheads with viscosities as low as 70 at 210°. These stocks have been dewaxed to zero cold test, have been subsequently fractionated into neutrals and bright stocks, so that it would appear that if the vacuum still is properly designed, constructed, and operated, it is entirely feasible to produce the entire lubricating-oil requirements by vacuum distillation, dewax the stock as a whole, and after dewaxing fractionate it into various grades of lubricating oil according to market requirements. So far there are no commercial plants which have gone this far in this connection. However, if the experimental work which has been done is indicative of what can be expected from future commercial installations, there seems to be no question but that the procedure will eventually round out into commercial form. It would have many advantages, particularly in light of the requirement for zero cold-test oils made from paraffine-bearing crudes, for certainly it is much cheaper to dewax the whole lubricating value of the crude centrifugally than it is to make an overhead bright stock on one hand which is to be centrifugally dewaxed, and then produce, on the other hand, a line of neutrals which can only result from low-temperature wax pressing which at best from the point of view of plant-investment requirements, operating cost, and yield, is not any too satisfactory.

There is one phase of dewaxing overhead distillates which is rather interesting. In the dewaxing of residual stocks it is necessary to bring the oil to color before undertaking the dewaxing operation. This has been due to the fact that it was impossible to precipitate the wax and subsequently separate it in the presence of the asphaltic bodies which are removed by decolorization.

In the case of overhead stocks quite the contrary is the case. It is not only possible, but in many instances desirable to dewax the stock just as it is received from the distillation unit. After the dewaxing operation has been completed, the stock can then be either filtered or acid treated and filtered, according to its nature, and brought to final color without loss in the cold test of the finished product.

It is a question, however, as to whether it is better to dewax these stocks prior to decolorization or after they have been brought to color. If they are dewaxed before decolorization, a considerable saving is effected for the reason that no money is spent in bringing the petroleum content of the stock to color, which has no advantage for the reason that the petrolatum in most plants has only the value of pressure-still charging stock. However, it can be pointed out that if the stock has not been decolorized before dewaxing, the dewaxing unit is called upon to handle a certain amount of material that eventually is discarded as a loss in the form of acid sludge as a result of subsequent treating operations. Inasmuch, however, as the cost of centrifuging is less than the cost of bringing the oil to color, and inasmuch as the loss to sludge in treating most overheads is, volumetrically, approximately the same as the petrolatum loss in dewaxing, it is rather felt that of the two procedures, the former has the advantage, particularly inasmuch as it permits the refiner to finish his stock with a filtering operation, and there is no question but what a dark stock, if free from suspended asphalt, will centrifuge to a considerable advantage in comparison with a stock that has been brought to final color before centrifugal dewaxing.

In conclusion, it may be said that a considerable amount of headway has been made in connection with the production of centrifugally dewaxable stocks by vacuum distillation. However, it is not considered that the problem has been entirely solved, and it is felt that the final solution will come only when it has been commercially established that it is feasible to produce from the crude a base overhead lubricating stock which can, after dewaxing, be subsequently fractionated by further vacuum distillation into each of the various grades of lubricating oil that may be required.

Arkansas Plant Specializes In Asphalt Products

(*Continued from page 82*)

seal on the packing gland, designed to form a vacuum tight joint between the packing and the rod. However, under the working conditions at this plant, the material handled by them was of a nature that maintained a temperature high enough that the water next the inner packing gland was converted to steam at times, forcing a part of it past the packing with a tendency to destroy the suction of the pump. Water was removed from the glands. A small pipe was fitted to the water connection supporting a larger piece acting as a riser and reservoir combined. The riser left open at the top was filled with heavy oil and the pump placed in operation. Immediately suction was established and no more failures were experienced in removing the bottoms from the base of the vacuum tower.

CONVERTING STILLS

Four converting stills are in service, three of which are utilized in the manufacture of the various grades of road material, roofing asphalt, and the various other asphaltic compound manufactured by this company. One of the stills or converters is built upon the supporting foundation without a firebox for heating the material while being oxidized. Material that is to be blown and processed only a short time is placed in this converter; the action of the air blowing through the mass maintains through oxidization sufficient heat to keep the mass in a fluid state. After the predetermined length of time that the material is to be left in this converter, checked by numerous laboratory analysis, the material when finished, is run to tank cars placed on the loading rack spur a short distance from the plant. Immediately after the converter has been evacuated of its contents, the lines are blown free of asphalt. If this were not done, the material would congeal or, "freeze" to the inside of the pipe.

The other converters or blowing stills, are equipped with fireboxes by which the temperature of the mass in process is heated during the oxidizing process. The fourth converter or blowing still, is used in the manufacture of mineral rubber. Great care must be observed at all times during the operation of this piece of equipment. The temperature is maintained near 500° F. during the manufacture of the mineral rubber, and the finished product must come up to rigid specifications laid down by the research department of the various tire companies purchasing the product. No moisture or foreign matter must be allowed to come in contact with it or the quality will be impaired. Immediately after the process is completed, the mineral rubber is drawn from the still and placed in barrels. No ductility is one of the points in the manufacture, and if a piece of it should be placed in the machine, it would fracture immediately.

Four converters in Jas. B. Berry Sons Company Asphalt Refinery at Waterloo, Arkansas. Last converter at left is Mineral rubber still.

Air with which the blowing is accomplished is forced through the mass in any of the converters by two Connersville rotary blowers placed in a building adjacent to the boiler house, which are operated by Allis Chalmers motors. During the oxidization or conversion process the air is constantly being blown through the mass in the converters until the desired specifications have been met. At that point, the finished product is removed from the stills to barrels or tank cars, depending upon the material made. That which is fluid at comparatively low temperatures is loaded in tank cars, while paving material is placed in light sheet metal drums.

Drums which are used in this plant are fabricated in the barreling shed near the loading rack. In the beginning, nested barrels were purchased, but owing to the varying size, together with the higher freight rates applying to this class of goods, their use was discontinued. The material from which the barrels are made is bought in sheets and die formed heads. A Niagara machine was set up with which the sheets may be trimmed, formed, crimped and fastened together. After this operation, they are placed in the heading machine where the bottoms are crimped to the sides of the drums.

In filling the drums with paving material or crack filler, or in fact any of the material other than mineral rubber, the barrels after being formed are placed on the side of a tough where they are given a coat of liquid lime on the inner side. Ordinarily without this application when the material is to be removed from them, the entire barrel must be placed in the cooking vats on the highways or other places of consumption to melt the contents. With the lime coating the drums may be split and removed from the contents so that it may be chopped or broken up in convenient pieces for utilization.

The plant was designed and laid out for a straight line flow, the raw material or crude coming into the plant storage at a point farthest from the loading rack, working its way through the various steps of the process to be finally stored near the railroad spur, or loaded directly without returning or backtracking in the progress of manufacture.

National Petroleum Association Hears About Oil Industry's Ills

APPROXIMATELY 200 attended the twenty-ninth annual meeting of the National Petroleum Association at Atlantic City September 16, 17 and 18, where they heard a series of reports and addresses by outstanding authorities on subjects of economic and technical importance. The political angle also was covered at the same place and at the same time in meetings of the American Bar Association and of its mineral law section and commerce committee.

The remarks of the economists and those who spoke from that angle were generally pessimistic, as might have been expected during a time of distress within the industry. The engineers and technical men who had places on the program, however, were unanimous in reporting substantial and continued progress in refining technology.

It appeared to be the general opinion of delegates of both associations that the oil industry is entering a definite political phase of tremendous historical importance. Henry L. Doherty said that "The oil industry, I believe, is passing into the hands of the politicians." There were many indications that oil may rank with wine and beer as one of the paramount issues of the next presidential campaign. Rush C. Butler, chairman of the Bar Association's commerce committee, said, for example, that "the federal government withheld its approval and the program (of curtailment) failed."

While members of the bar association did not express their opinions in such terms as did the members of the petroleum association, it nevertheless seemed to be the consensus among them that some drastic type of federal legislation is most urgently indicated.

There were two schools of thought among the lawyers, one supporting the bar association's program advocating the repeal of the Sherman and other anti-trust laws; and another minority opinion favoring the enactment of federal legislation for the closer regulation and control of the oil industry.

Formal approval of the bar association, however, was given to the report of its commerce committee recommending the modification of the Sherman law and offering a draft bill embodying that proposal for submission to congress.

E. M. Lyons, president of the petroleum association, attempted to strike a note of optimism in his opening address before that body, but Henry L. Doherty, who followed him, rejected his suggestion of better times ahead, as likewise, in effect, did every other speaker discussing subjects of an economic nature.

Dr. Joseph E. Pogue, consulting engineer, of New York, said that vast reserves of oil underground affect

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the market just as strongly and just as adversely as do our enormous stocks of oil above ground; that the industry is over-developed, over-capitalized, and rests upon an unsound method of competitive offset drilling; that curtailment of production alone will not remedy its ills; but that restriction of drilling, abridgement of plant expansion, and modernization of production methods are also required to place this department of the business in low-cost brackets and on a competitive basis with the rest of the world. Referring to the "recent extraordinary and extra-legal actions of the governors of Oklahoma and Texas," he said that "the importance of this action would appear to lie in the contribution that these state officials have made toward a breaking down of legal inhibitions that stand in the way of reforms so signally needed in the petroleum industry." "If this remarkable example of direct action should prove to be an opening wedge in the revision of the absurd and illogical law of oil and gas that disturbs the ethics and economics of a great industry, an important forward step will have been taken."

C. J. Bauer, of the statistical department of Standard Oil Company of New Jersey, said that the total potential production of the world now approximates 7,000,000 barrels per day, or 40 per cent more than will be required five years from now. This speaker also brought the unwelcome news that Constantza, a remote sea port, the location of which probably is unknown to nine out of 10 American oil men, has supplanted Houston and neighboring Gulf ports as the governing factor in establishing petroleum prices in the consuming centers of Europe.

Colonel George A. Burrell, consulting engineer recently returned from Russia, said that Soviet oil trusts will ship about 175,000,000 barrels of oil during the current fiscal year.

All officers of the association, including E. M. Lyons, president; P. S. Tarbox and N. H. Weber, vice presidents; Fayette B. Dow, general counsel, and G. B. Hunter, treasurer, were re-elected for another term.

High-Lights of the N.P.A. and A.B.A. Meetings at Atlantic City*

"THE oil industry is not going to throw a 12 billion dollar investment to the winds.

"Oil will continue as one of America's greatest industries, giving employment to hundreds of thousands of our citizens and ultimately yielding a return to those who have retained faith in its future."—E. M. LYONS, *president, National Petroleum Association.*

E. M. LYONS

* * *

"If there is a single suggestion before the oil industry now that carries any chance of success, I don't know what it is. The oil industry, I believe, is passing into the hands of politicians."—HENRY L. DOHERTY.

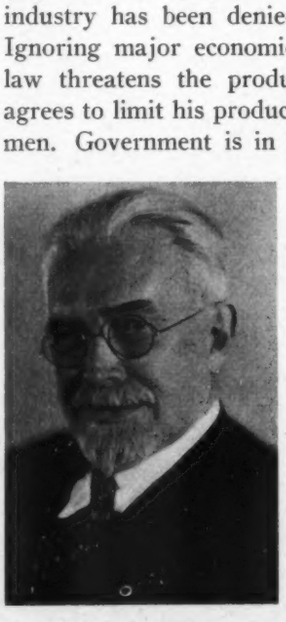
* * *

"And so today the American public is seriously aroused over the tragic plight of the oil industry and its apparent inability to solve its serious problems in its own way and without outside interference . . .

"Is it not time, therefore, to put some measure of legislative control over the bringing into the market of production from new fields? But one conclusion can be drawn. Control must be exerted . . ."—JAMES G. STANLEY, *before Mineral Law Section, American Bar Association.*

* * *

"Chaos is king. The Sherman law, a federal statute, encourages unlimited production. State governments *vi et armis* compel a complete shutting down . . . Being unable because of the Sherman law reasonably to curtail production, oil operators have been required at the point of the bayonet to cease all operation. Thus this industry has been denied its right of self regulation. Ignoring major economic considerations, the Sherman law threatens the producer with imprisonment if he agrees to limit his production to the needs of his fellowmen. Government is in business. It is the dominating factor in the oil industry today. More than two years ago the industry expressed its willingness to acquiesce in a program of qualified curtailment of production if approved by the authorities of the federal government and of the states affected. In spite of the soundness of the economic condition which would be created if the agreement were put into effect, the federal government withheld its approval



HENRY L. DOHERTY

*National Petroleum Association, September 16, 17 and 18; and American Bar Association, particularly the mineral law section, September 17, 18 and 19.

and the program failed. The cooperative effort of the Federal Oil Conservation Board and the industry covering a period of more than four years came to naught. The chaotic condition in which the industry found itself years ago has continued uninterruptedly to this day . . . The plight of the men engaged in the production and distribution of oil cannot be described. They are subject to a disorder detrimental to their business and disgraceful to our form of government. The Sherman law is on one side of them and martial law on the other."—RUSH C. BUTLER, *chairman, commerce committee, American Bar Association.*

DR. JOSEPH E. POGUE

* * *

"Leaders of the oil industry are just beginning to think that if this depression lasts long enough and if conditions really get bad enough we shall have to get down to a consideration of fundamentals . . .

"Gasoline stocks should be held down to 40,000,000 barrels, as of April 1, 1932.

"The present rate of production of gasoline is absurdly large, considering the sharp seasonal decline and the general downward trend.

"Output of gasoline must —and will—be curtailed, before or after a further decline of prices."—DR. JOSEPH E. POGUE.

J. H. DOOLITTLE

* * *

"Notwithstanding the over-production of oil and gasoline of which you speak, there is a shortage of aviation gasoline of the most satisfactory grades, which can be made only from the crudes of the Gulf Coast, Smackover, and California." — MAJOR JAMES H. DOOLITTLE, *transcontinental record-holder.*

C. J. BAUER

* * *

"The daily potential foreign production is 2,298,577 barrels. Adding the potential of the United States, we get a total of 7,000,000 barrels, or about 2,000,000 barrels a day more than we figure will be necessary five years from now."

GEORGE A. BURRELL

Regarding Roumania—

"This (Roumanian) surplus comes into direct competition with the exports from the United States; so much so in fact, that early this year prices f.o.b. Constantza (Black Sea port) were the governing factors in establishing prices in the consuming centers of Europe, instead of the United States Gulf export price . . .

"The statistics which I have given certainly indicate a decided trend toward lessened movement of both crude oil and products from the United States to foreign markets. The dislocation of foreign trade balances has led some nations to encourage the establishment of their own refinery operations through the imposition of tariff barriers. Such artificial stimulants to home industry offset, perhaps, the greater ability or other advantages of exporters who have carried the business to its present advanced state. Against this somewhat gloomy estimate it should be set out that a large part of the world is still woefully behind in its per capita consumption of petroleum products. If other nations used a small part of the per capita consumption of the United States there would not be enough oil today to meet the demand. Therefore, I think it reasonable to expect that as the standard of living rises the world over there will grow with it such an increase in demand as to make the new competition of foreign fields and foreign refineries welcome rather than a menace."—C. J. BAUER, *statistical department, Standard Oil Company of New Jersey.*

* * *

"Soviet oil trusts will ship about 175,000,000 barrels of oil during the current fiscal year . . .

"The increasing demand for anti-knock gasoline is a source of great worry to Soviet refiners, whose output is of a very low octane rating, and who do not dare to appropriate the ethyl patents." — COLONEL GEORGE A. BURRELL, *recently returned from Grozny, U. S. S. R.*

D. G. BRANDT

* * *

"The gasoline of today is a very different product from that of a few years ago . . .

"Butane and propane have a brilliant future in

ALFRED FISHER

the commercial field, not only for domestic use as now sold, but also for industrial purposes—such as heat treating, to give one example. For such purposes, these by-products of our industry are equally as good as natural and artificial gas."—D. G. BRANDT, *Crew Levik Company.*

* * *

"Increased anti-knock value, increased yield of gasoline from the stock processed and increased length of run are the three primary objectives in the operation of cracking equipment today.

"These are obtained to a substantial degree by coking outside the cracking zone, which development is another step forward in the conquest of coke as a factor limiting the operation of cracking equipment . . .

"Work . . . has been conducted recently with very promising results."—ALFRED FISHER, *Universal Oil Products Company.*

* * *

"The oil industry may be losing its markets for lubricating oils without being aware of it; this as a result of the consolidation and centralization of the power industry and the abandonment of old-time steam engines.

J. D. GILL

"The Insull interests alone recently shut down 476 small power plants, whose consumers are now being served from large central plants using less lubricating oil per unit of horsepower than did the many small plants of yesterday."—JOHN D. GILL, *Atlantic Refining Co.*

Recent Developments in Refining Methods

By D. G. BRANDT
of Crew Levick Company

WITH the present economic conditions of the country, over-production of crude and low prices, the refiner's chief interest during the past year has been to keep the red ink off the "Net Profit" line of his balance sheet and to maintain his cash position. This condition has resulted in reduced research schedules and few plant improvements.

The automobile manufacturer is in about the same position as the refiner and has made only minor changes in engine design. A few manufacturers have incorporated oil coolers and temperature control on the lubricating system but it has not as yet been universally adapted by all manufacturers. The average compression ratio is substantially the same as last year, some makes have increased compression ratios slightly while others which were relatively high have been reduced, thus bringing the average to about the same figure.

Most of the recent development from the refiner's point of view has been in motor fuel and its production. With the over-production of crude and increased amount of cracking, the volatility of the gasoline was increased to a point where vapor-lock became one of the major troubles of the motorist. Vapor-lock is the boiling of the gasoline in the fuel feed system which causes interruption of the fuel supply to the engine. The point at which vapor-lock occurs will depend upon the design of the fuel feed system, the vapor pressure of the gasoline, atmospheric temperature and altitude. The first is controllable by the automobile manufacturer and the second by the refiner. The fuel feed system should be designed in such a manner that the fuel temperature is kept at a minimum until it has reached the carburetor. This apparently has not been given serious consideration by some car manufacturers as test data taken on various makes of cars show temperature rises in the fuel in passing to the carburetor as high as 80°F. above the atmospheric temperature when the car was idle after being run at a constant speed of 40 miles per hour. Another car when operated under the same conditions showed a rise in temperature of only 27°F. This indicates that the first car would require a gasoline having a Reid vapor pressure of approximately four pounds, while the latter would not vapor-lock on a gasoline of 9.5 pounds vapor pressure.

VAPOR PRESSURE INCREASED

It has been known for a number of years that ease of starting and rate of acceleration of a car increase with

increased vapor pressure or volatility of the fuel and the refiner has been striving to produce such fuels. During the past year he has arrived at that point only to find that the average automobile of today cannot use such volatile gasolines on account of vapor-lock. Thus the motor fuel being supplied today is a compromise and will of necessity be such until the present cars are replaced with cars equipped with proper designed fuel feed systems in which all heat is kept away from the fuel until after it reaches the carburetor.

The average Reid vapor pressure of the summer grade gasoline now being sold is approximately seven pounds. The average rise in temperature on various makes of cars on idling after a 40-mile per hour run is slightly over 50°. If this average were reduced to one-half its present value gasolines of 10 pounds vapor pressure could be used to the benefit of both refiner and motorist.

During the year the industry has put the new yardstick for measuring the anti-knock quality into use; that is the octane number is being used in specifications and like all new tests is much in the foreground. Volatility which had been considered the most important property of a motor fuel is now in second place and octane number has replaced it. Although the new C.F.R. engine for testing anti-knock has not been officially approved, it is available for use and fairly consistent results are being obtained with it. As yet there has been very little work done on the correlation of engine performance in road tests with various octane number fuels. This must be done before the true value and limitations of the tests can be established.

The highly competitive situation in the gasoline market has forced the refiner to continuously raise the octane number of the regular grade of gasoline until the average difference between the regular grade and premium fuels is approximately nine octane number and in many cases lesser differences are indicated. Thus we find the gasoline of today a very different product from a few years ago and the equipment necessary to produce such fuels requires large plant investments and continuous research to meet the specifications from the various types of crudes available.

MORE CRACKED GASOLINE

To meet the requirements for higher anti-knock fuels the refiner has had to send a higher percentage of his crude runs through the cracking equipment. But even this now falls short of the requirement when the plant is processing a crude of high natural gasoline content. An average Mid-Continent crude when processed for maximum gasoline yield in the usual topping and cracking operation will yield a gasoline of approximately 65 octane number when the straight run and cracked gasolines are blended together. Various types of cracking equipment may vary this figure slightly. This seems to be the limit for this type of operation and has brought a new type of operation into use commonly referred to as "Reforming." With this type of operation the gasoline is cut into two fractions, a light gasoline and a heavy gasoline or naphtha. The heavy gasoline is sent through the reforming unit and cracked at high temperature under pressure and the balance of the crude is cracked in the usual manner. The gasoline from the three sources when blended together will have an octane number of 70 to 71.

Similar results can be accomplished in cracking units designed to crack the crude direct but the variations in these units for handling various grades of crude somewhat complicates the design, and such units generally do not always fit into an existing refinery picture. They do however fill a need when building a new refinery (if that will ever be done again) or for increasing the capacity of an existing plant where all the additional crude is to be run entirely to gasoline.

GUM CONTENT

Low pressure vapor phase cracking, although producing high anti-knock fuels, has not met with a high degree of success due to the high gum content of the fuel and lack of stability over a period of time. Vapor phase coils have been used in combination with liquid phase units with some degree of success but here the major quantity of gasoline is produced from the liquid phase and the combination of the two products at the high temperature tends to stabilize the vapor phase product.

All cracking units produce fixed gases and an excess amount of butane over and above the amount that can be used in the present-day gasoline. The amount of these products that is retained in the pressure distillate will depend upon the pressure and temperature of the condenser system and if not removed will result in high treating and rerun losses and high vapor pressure gasoline.

This condition has brought into use the pressure distillate stabilizer. The design of these units is similar to the stabilizers used in absorption gasoline plants, and they serve a similar purpose. They are nothing more than a very efficient fractionating column, designed for close fractionation and to operate under pressure. The operation of these units is somewhat different than the usual distillation equipment in that the major control is at the bottom of the column rather than the top. The bottom conditions are set to pass distillate of a given vapor pressure while the top is controlled to pass all the hydrocarbons lighter than butane and the excess butane over that not required for producing the proper vapor pressure distillate. The reflux ratio is relatively high and such that substantially none of the hydrocarbons heavier than butane will be carried out with the gas. If there is a market for butane and propane these products can also be recovered, but this recovery will require additional columns to make the separations. With the proper use of stabilizers substantially all propane can be removed and the proper amount of butane retained to produce a distillate of the desired vapor pressure.

Safeguarding Tube Still Operation

WHEN tube failures occur in pipe stills, unless some means of rapid evacuation of the oil in process is provided, the result is in most cases a fire which not only burns the oil in that part of the system, but several of the remaining tubes must be replaced. Those in the banks not seriously damaged by burning are usually sagged to such an extent that they too must be replaced when the furnace is repaired after such tube failures occur.

Side view of tube extensions and steam connections in Louisiana Oil Refining Corporation's Bossier Refinery.

Having 10 furnaces, some of which are straight liquid phase and some on combination liquid and vapor, Louisiana Oil Refining Corporation has experienced tube failures at different times the same as other refineries which operate at regular cracking temperatures and pressures. To overcome the difficulties arising when tube failures do occur, J. A. O'Neill, superintendent of the Bossier City refinery in a suburb of Shreveport, Louisiana, has installed a couple of interesting pieces of equipment, one of which acts as a preventive of sagging tubes, while the other is operative when the tubes must be freed from oil in a minimum amount of time.

The first of these two interesting pieces of operating apparatus is a series of air cooled tube supports. These are placed in all the furnaces of the nine cracking units. The other one is a means of cleaning the tubes of oil by steam pressure when found necessary in case one of them should leak into the combustion chamber beneath the banks of tubes.

In the first instance, a baffle wall was built between the two fires in the furnace (they are fired from each end) upon which old tubes were placed at right angles to the cracking tubes. Those supports extend through the walls of the furnace with the ends protruding. A double row laid close together was placed with one end slightly flattened. At this end, a steam line was installed with one-quarter-inch jets placed, through which steam may be injected during the time of operation of the furnaces. At the opposite end of the supporting tubes a small brick stack was built integral with the wall of the furnace, which directs the steam and air upwards to the roof of the setting. Sufficient air is directed through these tubes to maintain a temperature low enough that they remain stiff supporting the operating bank without sagging. When the furnaces are fired, the steam is turned through these jets and remain opened during the operation of the cracking unit. A throttle valve is in the steam line leading to the jet headers by which the operators

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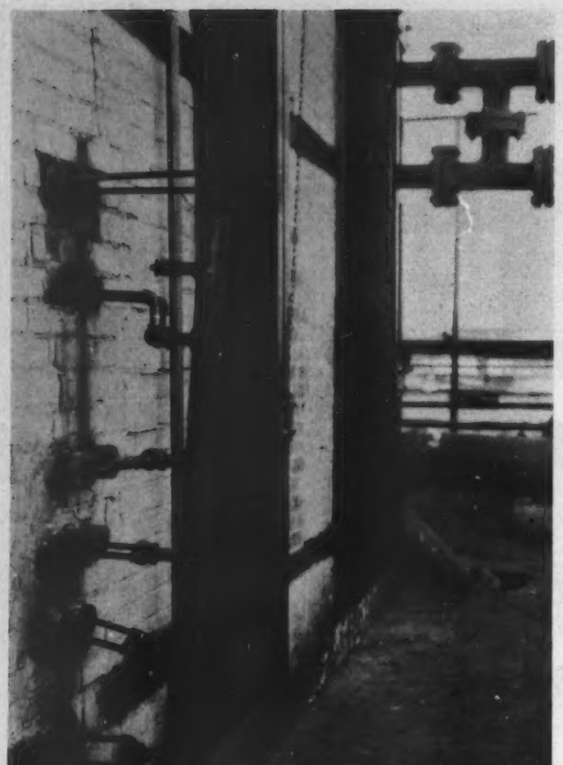


Close-up of steam jet installation in end of supporting tubes. Louisiana Bossier City refinery.

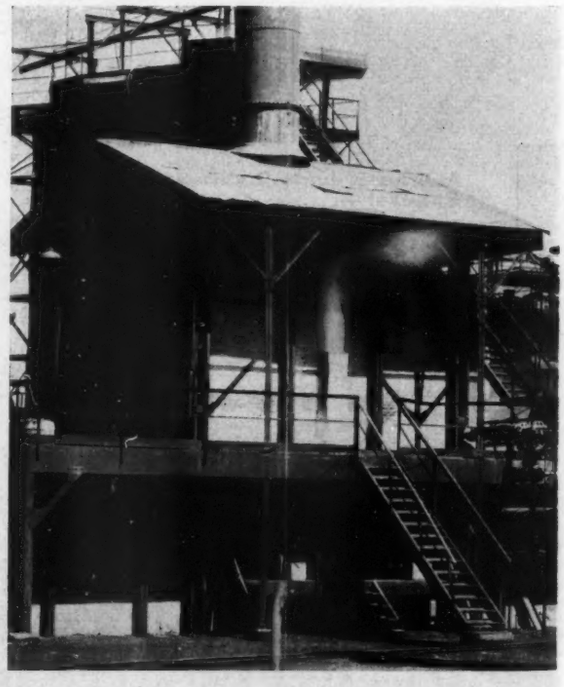
may admit the required amount to maintain a draft through the supports.

In the other case, should the necessity come about where it would be essential that all the oil in the tubes be removed in a minimum amount of time after a tube failure, this can be accomplished within three minutes after this apparatus is placed in operation.

UNLOADING COILS

In one of the "returns" of each bank of tubes, an extension was made through which the tube extension was led outside the furnace, coming out far enough to be clear of the walks and structure surrounding the unit. Heavy flanged tees were made up on the end of each extended tube—running—between which tees was flanged a high pressure high temperature gate valve. A reducing flange was bolted to the outer end of each one of the tees, to which was connected a two-inch line through which steam may be admitted to the tubes. This two-inch line from each one of the reducing flanges was led to the under side of the walk at the side of the furnace, to which a live high pressure steam main was led. A steam trap was placed under the junction of the two-inch and main steam line to prevent water from accumulating, and at the same time maintained a supply of dry steam at all times for instant use. Between the main steam line and the two-inch flanged to the heavy tees, high pressure two-inch gates were installed for throttle valves by which the operator may open when steam is needed. To the stem of the heavy gate valve between the tees, a wheel was attached instead of the usual hand wheel. This wheel is too high for the operator to reach from the ground, so a chain was installed by which the valve may be opened or closed from the ground in a moments time.

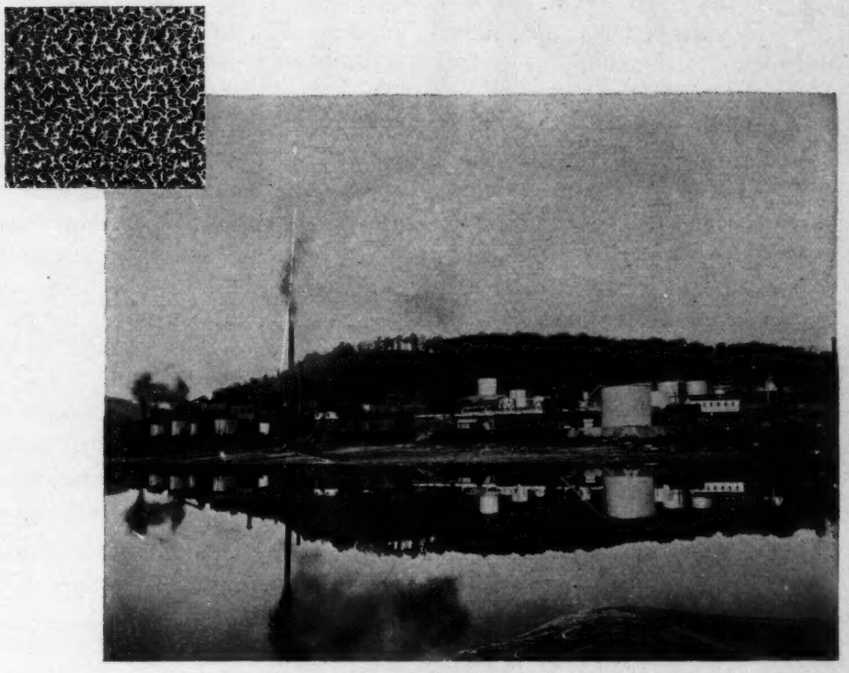
When in operation, this heavy gate between the tees remains open permitting the circulation of the material in process to flow through it. The lines, both steam and tube extensions are insulated to conserve the heat. Should a tube rupture or leak occur in the combustion chamber of the tube furnace, it only requires a moment for the operator to give the chain a sharp pull to begin closing the gate, after the pumps have been shut down and the evacuating lines have been opened. By closing this gate the oil in either of the two banks of tubes is prevented from flowing to the other. At the same time, the operator opens the steam gate valves on the lines leading to the tees, admitting a stream of high pressure dry steam to the tubes in the furnace. The volume is great enough that the tubes may be cleaned of the remaining oil within three minutes, where before their installation, it required 15 or more minutes to remove the oil. In the meantime, without the evacuating system, the temperature in the combustion chamber would usually run high enough that several of the tubes would be burned necessitating replacement. The saving in burned tubes since the installation of these two "kinks" has more than paid for the installation in all nine furnaces.



Vent on side of furnace showing steam and air leaving the support tubes.

in REFINING

The PLANT



THE Emlenton Refining Company is a subsidiary of the Quaker State Oil Refining Corporation. This Company has been successful over an operating period of more than thirty-five years. They are refiners of strictly 100% Pennsylvania Grade Crude Oil and hold a position in the industry second to none.

Their plant is equipped with the most modern refining appliances known to the industry. Officials of the Emlenton Refining Company are well pleased with their Dubbs unit installation and say it is giving excellent results in producing gasoline of high octane value.

Their plant at Emlenton is conceded to be one of the most modern in the industry.

WE can't see it in any other way but that the making of this record marks a very distinct advance in refining.

TRANSIT PUMPS are used exclusively in the operation of this unit—a reflux pump, a charging pump, a residuum pump, a clean-out pump, a fuel oil pump and an absorption column pump.

The engineers of Universal Oil Products Company, working with our engineers decided on the particular size and type of TRANSIT Hot Oil Pump used. That their selection was wise has been proved.

The selection of the proper hot oil pump for an installation is an engineering proposition. TRANSIT has the engineering talent to give you the best of service along this line No obligation, of course, expressed or even implied.

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GAS ENGINES GAS ENGINE GAS COMPRESSORS

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Hypochlorite Treatment of Natural Gasoline

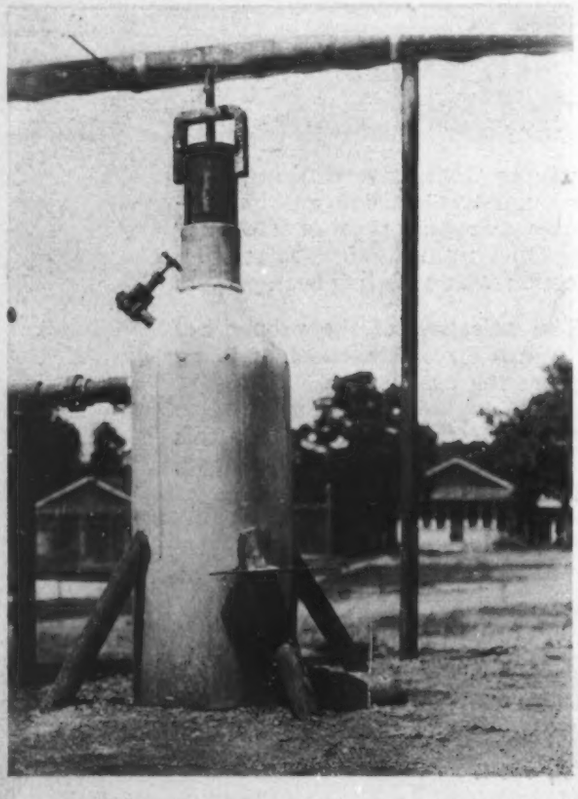
THROUGH some minor changes and additions to existing equipment, the treating system of the Shamrock, Oklahoma, natural gasoline plant of Magnolia Petroleum Company has been converted for the use of H T H, a chemical recently introduced into the petroleum industry by Mathison Alkali Works, Inc. This chemical is a true calcium hypochlorite and the trade name H T H is a contraction of the term "high test hypochlorite." Its properties give it many advantages over chlorinated lime.

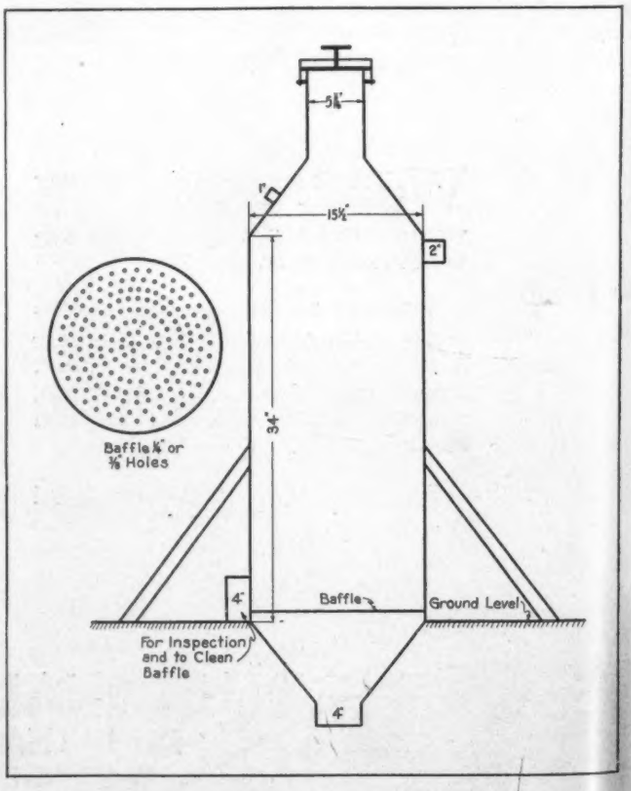
In adapting the old equipment to the use of H T H the engineers at the Magnolia plant set out to take full advantage of what the chemical offered. As the equipment is now operated it is a continuous system, wholly enclosed. Except in the addition of the daily charge of H T H and the bringing of the treating solution up to required strength at intervals, the work of keeping the gasoline output sweet is automatic.

The addition made in equipment is chiefly a container, set near the old treater and so piped that additional chemical can be forced into the solution by the manipulation of valves. This container is a cylinder, cone-shaped at each end. The lower end is set in the ground. Just above the bottom cone is a baffle plate. A plug for inspection and to allow cleaning of the baffle is in the wall of the cylinder. Operation of the equipment, however, has not required cleaning of the baffle or any other part of the treating system.

The upper end of this container is equipped with an opening for the addition of the daily charge of H T H. After the charge has been added, the container is made tight by a lead gasket connection, which is held in place by a one-inch bolt. A vent in the top cone is provided so air can be released when additional water is needed.

Piping from the treating system is so arranged that the course of the gasoline can be diverted from its





Detail of Chemical Container

HIGH KNOCK RATING GASOLINE

THE maximum benefit of cracking in producing high knock rating gasolines can be obtained only if all the fresh feed charged is forced to make at least one pass through the cracking coil. Inclusion of a small percentage of uncracked light ends from the fresh feed lowers the octane rating of pressure distillate several degrees. Possibility of contaminating the pressure distillate by these light ends can be eliminated by introducing the fresh feed on the discharge side of the high-pressure hot feed pump and heating the total feed in high-pressure heat exchangers. The high-pressure heat exchanger makes it possible to obtain maximum pre-heat to the coils at no sacrifice of knock rating.

Application of high-pressure heat exchangers between vaporizer and bubble tower also decreases the load on furnace and bubble tower, making greater throughput possible with lower furnace temperature, better fractionation in the tower, and closer regulation of endpoint.

The Leach High Pressure Fracto Condenser is a thoroughly proven construction. Over eighty are now in service in more than thirty plants, including the most modern cracking coils for the production of anti-knock gasoline from Pennsylvania and Mid-Continent crudes, and also, older coils remodeled by the addition of High Pressure Exchangers.

Leach constructions patented in the United States and Foreign Countries.

C. H. LEACH CO., Inc.
9-11 Park Place New York

LEACH Fracto Control TRADE MARK REG.

22

normal flow and force it to pass through this container. By closing a valve on the pump suction line the gasoline is forced into the top of the container and passes out through the bottom, picking up sufficient chemical to bring the solution up to required strength. When this has been accomplished the suction line valve is opened and the gasoline stream reverts to its normal course.

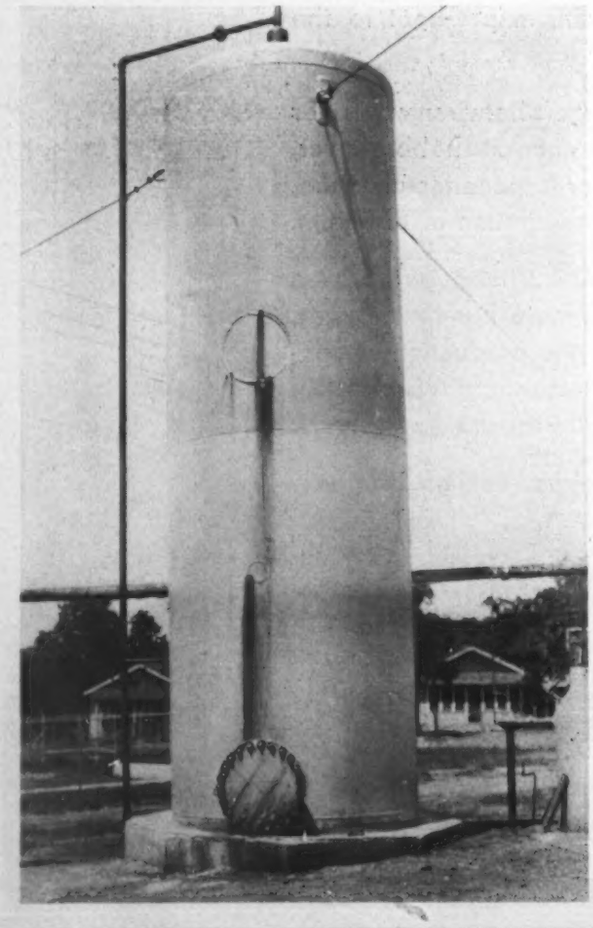
Raw gasoline is delivered to the treating system in conventional manner. It is discharged into the bottom of the treater through a spray. Contact with the H T H solution brings it up to specifications and it is drawn off near the top of the treater and delivered to storage. One pump is sufficient for the whole operation, whereas two pumps were required for the treating and delivering when other chemicals were used and the open vat was a part of the treating system.

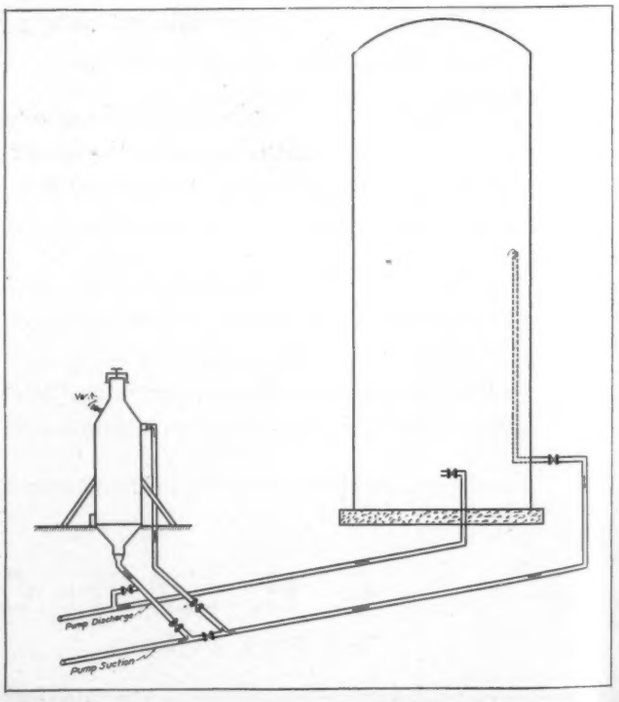
Careful checking when the present chemical was adopted revealed that eight pounds of H T H were required for each day's plant output. So once each day the eight pounds of H T H are introduced into the top of the container and this is the only time that it is necessary to handle the chemical. The chemical is shipped in drums. At the Shamrock plant a small house was built and equipped for weighing out the required amount each day. This piece of equipment is novel in that it allows the weighing out of the required amount without the loss of chemical. The head of the drum is cut out and the drum up ended on a tripod, which has a top plate and a ring into which the drum fits. A hole in this top plate allows the chemical to fall through a pipe when a rotating paddle is turned. The device for carrying the chemical is swung from scales. The chemical continues to fall into this device until the eight pounds are registered. When the chemical is carried across the plant yard and dumped into the container.

At the Shamrock plant the requirement is for 1.32 pounds of H T H for each 1000 gallons of gasoline. When treating with bleaching powder the requirement was six pounds for each 1000 gallons. The Oilton plant of Magnolia Petroleum Company has required 1.8 pounds of H T H against seven pounds of bleaching powder for each 1000 gallons.

Advantages credited to H T H are: It forms no sludge; it can be stored for long periods under normal atmospheric conditions without appreciable loss of chlorine content; only a small amount of this chemical needs to be handled because of its high chlorine content.

Since it is stable, solutions may be prepared under fixed conditions, for the same amount of chemical will give identical concentration. Solutions may be formed in a short time, because of its easy solubility. This high solubility makes it possible to get the full value of all available chlorine. The low lime content leaves no deposits to be formed in piping of a treating system.





Detail of Treater, showing connection to Chemical Container.

Tight times challenge able men but do not scare them

Refiners can face the future with confidence Every year more motor cars go into service — every year motorists buy more gasoline — more cracked gasoline

Dubbs cracked gasoline suits today's automobile engines Straight-run gasoline does not; it knocks

There is too much fuel oil in storage

It is wasteful to skim crude to make unsalable straight-run gasoline and increase the surplus of fuel oil

It is economical to Dubbs crack stored fuel oil, making anti-knock gasoline and reducing the fuel oil surplus

The Dubbs cracking process points the way to profit for refiners everywhere

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

This Steel Loading Rack Designed for Safety

SAFETY is worth much in loading rack design. Many times the man when loading tank cars must lift "two by twelves" from the rack floor to skid them over to the running boards under the domes and play the tight rope artist with both hands full of sample bottles, seals and thermometers. He must exercise extreme caution under these conditions, especially in cold weather when ice and sleet covers his "board walk."

Loading rack of the Empire Oil & Refining Company showing counter weight attached to cable.

An inexpensive method of providing a safe means of communication between the loading rack and the tank cars has been built by Empire Oil & Refining Company at the rack in Tallant, Oklahoma. The rack is all steel, built from pipe, with a grille floor. Later, wood bridges were installed by which the man on the rack may pass from it to the tank car with ease and safety to himself and equipment.

These bridges were constructed by using "two by four" sills, fastened to the rack by strap hinges. Upon these sills were nailed "one by fours" spaced so that nothing can cling to them and pile up. To each end of the "two by four" sills were nailed "two by four" risers, each pair on the sides being connected at the top by "one by fours," forming hand rails to guide the loader.

To make these bridges more convenient, two-inch pipe risers were welded to the sills of the rack, extending up far enough that when the top of the risers were slotted and pulleys inserted, wire cable could be rove through them, with the other end fastened to weights sufficiently heavy that the bridge is easily balanced. The weights in this case are made from eight-inch pipe line collars with cement poured into them, after a heavy wire bail had been inserted to which the end of the cable could be attached. When approaching the car to be loaded, the loading rack man need only step on the bridge permitting his added weight to counteract the weight on the other end of the cable when the bridge lowers immediately to the running board of the car. When finished with the car, he need only to give the cable a pull, assisted by the weight, and the bridge is raised in place away from the car.

Obviously this type of loading platform is popular with the safety committee and others interested in keeping down the accident rate.

Lubricants and Cylinder Stocks Recovered Under High Vacuum

(Continued from page 77)

would seem to be the general requirement depending upon the boiling range of the material condensed and the degree of vacuum on the system. Large primary condensers are required to take care of the increased load where recirculation of overhead condensate to the column is used in conjunction with dry vacuum. Nusselts equation is of use in estimating the condensing surface requirements for horizontal tubes. (Nusselt Z. Ver dent. Ing., 60, 54, 1916).

The pressure drop through the column must be low and should not be greater than eight millimeters of mercury. Five millimeters or less are attained in good installations. Large vapor uptake area and shallow cap slot submersion are essential to efficient operation. In order to provide full operating flexibility not less than 1¼ square foot free vapor space per barrel of raw residuum per hour should be allowed with the upper limit around 1½ square foot per barrel per hour. The vapor pipe area through the collecting pans is from one-tenth to one-fifteenth of that of free space area. The vapor uptakes on the bubble trays is approximately twice that of the vapor uptakes through the collecting pans, slot area one-half to one-third that of the vapor uptake area with only slight submersion. The collecting or run down pans divide the column into sections. Bubble trays are placed between the collecting pans and above the top collecting pan above which a large free vapor space allows the spray to settle before passing to the condensers.

The entire column is provided with manholes giving ready access to the plates when cleaning becomes necessary due to the coke deposits beneath the bubble caps and in the slots. A dirty tower is evidenced by increase of pressure drop.

The chimneys or vapor uptake pipes through the collecting pans are shielded from run down from the bubble traps above by cones which deflect the liquid from the openings. Needless to state the entire system inclusive of auxilliary connections is made entirely vapor tight in accordance with the best mechanical development for vacuum technique. Small leaks seriously interfere with the efficiency of heat transfer and condensation. As a safeguard to the maintenance of steady vacuum, the stem jet ejectors are made larger than estimated by theory and as an added precaution are backed up by steam jet air pumps.

In this article the writer has made no attempt at a complete treatise on the vacuum distillation of lubricating oils. The objective has been rather to touch some of the high points not covered in the present literature on the subject.

THE MONTH IN REVIEW

Up to the Refiner

THAT there has been material improvement in the statistical position of the petroleum industry, in practically all of its branches, no one can deny. Stocks of crude oil have shown a decline as of August 31, since the beginning of this year amounting to 36,662,000 barrels. While inventories of all refiner products have not shown a decline, but have shown a slight gain since the first of this year, the fact remains that gasoline stocks have been reduced to the extent of 3,351,000 barrels during that period. Considering all factors of the various branches of the industry, it is difficult to understand why market values of crude and refined products have failed to reflect improved statistical conditions.

The producing branch of the industry has succeeded fairly well in getting its house in order and, right now, is in a position to command higher prices for crude. However, complications persisting in the refining and marketing branches of the industry act as a deterrent to a higher crude market. Refiners continue to complain about their market situation and offer collective thought to show that they cannot afford to pay more for crude oil in the face of existing market conditions. Thus, the producer is denied the right to participate in a rightful reward for his efforts to prevent over-production of crude oil.

It is up to the refiners of the country to recognize the fact that they are now the remaining obstacle to general market improvement. If every refiner will determine to trim his production schedules to the point where it will be necessary to continue substantial withdrawals of gasoline from storage to suply the current demand, marketing troubles will rapidly disappear. The time has arrived when every branch of the industry should avail itself of the favorable influence of an improved statistical position. The watchword now is produce less than your market requirements and put up a united front for prices that will insure a reasonable profit.

Too long has it been the rule in the oil business to measure efficiency by volume of production rather than in dollars of profit.

College Courses in Petroleum Industry

THE American Petroleum Institute has been informed that two courses of study on the petroleum industry in the United States and its relation to developments in foreign countries are being offered this year at New York University School of Commerce, Wall Street division. Both courses will be given by Professor Ernest R. Lilley, author of "The Oil Industry," and other books.

One course, "The Oil Industry and Company Operations," deals with fundamental aspects and problems of the industry. It is given Wednesday evenings from 5:15 to 7 o'clock.

The second course, "The Oil Marketing Executive's Course," is primarily for discussion of both technical and commercial aspects of oil marketing. It is given Monday evenings from 5:15 to 7 o'clock.

Information is available from the University, Room 207, 90 Trinity Place, New York, N. Y.

Lubrication Corporation

BENDIX Aviation Corporation and Standard Oil Company (Indiana) have associated themselves in formation of Lubrication Corporation for the manufacturing and marketing of grease fittings for all makes of automotive and industrial machinery, grease dispensing equipment, automotive lubricants, and lubrication service.

Announcement to this effect was made recently by Edward G. Seubert, president Standard Oil Company, and Vincent Bendix, president of Bendix Aviation Corporation.

Engineers are now at work designing the machine tools to be used in manufacturing the new equipment at the Bendix plant at South Bend, Indiana. Chemists in the Standard of Indiana plant at Whiting, Indiana, have perfected the formulas which will be used in manufacturing special greases for use in connection with the new system.

The new company has been incorporated in Delaware to be owned equally by Standard of Indiana and Bendix Aviation. Its name is temporary and will probably be changed later. The officers and directors are R. P. Lansing, president; M. W. McConkey, vice president; Bruce K. Brown, vice president; J. A. Watson, secretary; W. J. Buettner, treasurer, and N. R. Grimshaw and L. C. Welch. A. Y. Dodge is general manager. Messrs. Brown, Grimshaw, Welch and Watson are Standard Oil executives, the remainder Bendix executives.

Ethylize Regular Grade of Gasoline

IMPERIAL Oil, Limited, Toronto, Canada, has secured permission from Ethyl Gasoline Corporation to mix Ethyl fluid with its regular grade gasoline to improve its anti-knock rating. This improved gasoline is to be sold as Imperial Three Star, but at the former price. The pumps from which this brand is dispensed, however, will bear the warning that the gasoline contains lead and is not to be used for any purpose except that of operating an internal combustion motor. The new Imperial gasoline is colored green, and is sold for 3½ cents less per Imperial gallon than Imperial Ethyl.

According to the contract the maximum octane number allowed for this new product is eight octane numbers below the octane rating of Imperial Ethyl, with a minimum rating of 65.

Reduction in Freight Rates

A saving of several millions of dollars annually in railroad transportation of refined oils in Texas is expected to result from the reduction in rates which went into effect September 10 following issuance of an order by the Railroad Commission authorizing the reductions.

The rates which are involved have been in process of readjustment for approximately 2½ years, and the new rates were put into effect principally so that the railroads can meet truck competition for short-haul distances, although it was long contended that the old schedule of rates on refined products was too high for the industry.

The new schedule begins at nine cents per 100 pounds for hauls of 10 miles or less, as against at rate of 15½ cents per 100 pounds under the old schedule where single line rates applied or a rate of 21 cents where joint line rates applied, the latter representing hauls where it was necessary for more than one railroad line to handle shipments, while the smaller rate was

for hauls between points where hauls over a single line were possible.

Under the new schedule the rate of 39 cents is reached at 500 miles and over 475 miles. Under the old schedule the maximum of 39½ cents was reached at 120 miles for single line rates and at 95 miles for joint line rates.

The new rates are based on short line mileage without regard to single or joint line mileage.

ECONOMICS

Crude Oil Production Up

CRUDE oil production in the United States is now at a daily average rate of 2,147,450 barrels. Figures reported to the Bureau of Mines for the month of August show that the daily average during that period amounted to 2,207,000 barrels. East Texas production has been held below 400,000 barrels a day since the lifting of martial law there, but the rapid rate at which new wells are being completed indicates that the trend of production will probably continue upward. There are now more than 2300 wells in East Texas, with a rated allowable production of about 425,000 barrels a day. If production in East Texas continues to mount, as it undoubtedly will, it is believed that the Railroad Commission of Texas will take measures to reduce the well allowance from 185 barrels a day to a figure that will prevent waste incurred through over-production.

World Crude Oil Production

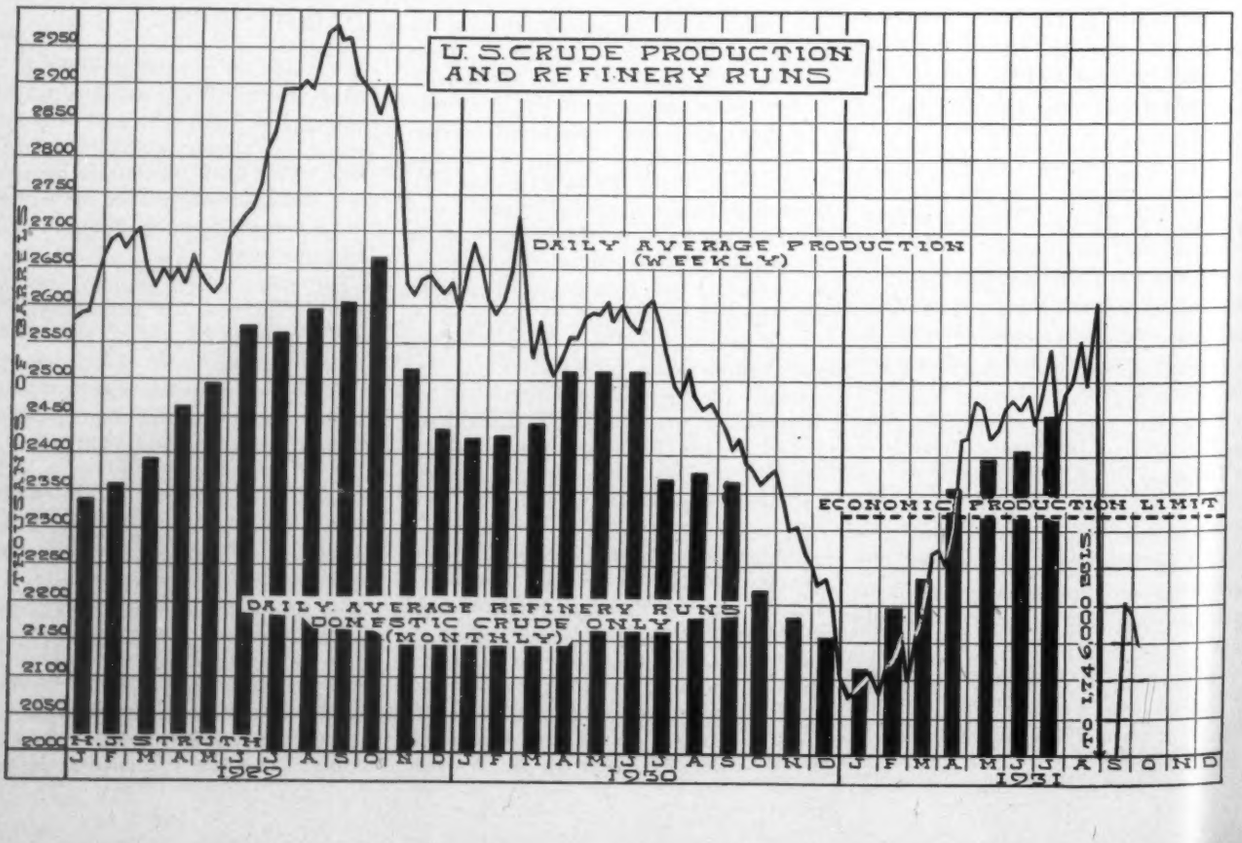
WORLD'S production of petroleum in 1931 has been estimated by Valentin R. Garfias, Foreign Oil Manager, Henry L. Doherty and Company, New York, at a total of 1,379,000,000 barrels, or about 39,000,000 barrels less than was produced in 1930. His estimates show that 1931 production of oil in the Western Hemisphere, notwithstanding available over-supplies, will decline close to 69,000,000 barrels while the aggregate production of the Russian, Roumanian and Persian fields will increase about 32,000,000 barrels. Crude oil production of the United States for this year is estimated at a total of 856,000,000 barrels, against 898,000,000 barrels in 1930 and 1,007,323,000 barrels in 1929. Russia's production will probably increase to a total of 158,000,000 barrels, against 135,165,000 barrels in 1930 and 99,507,000 barrels in 1929.

Stocks of All Oils Decline

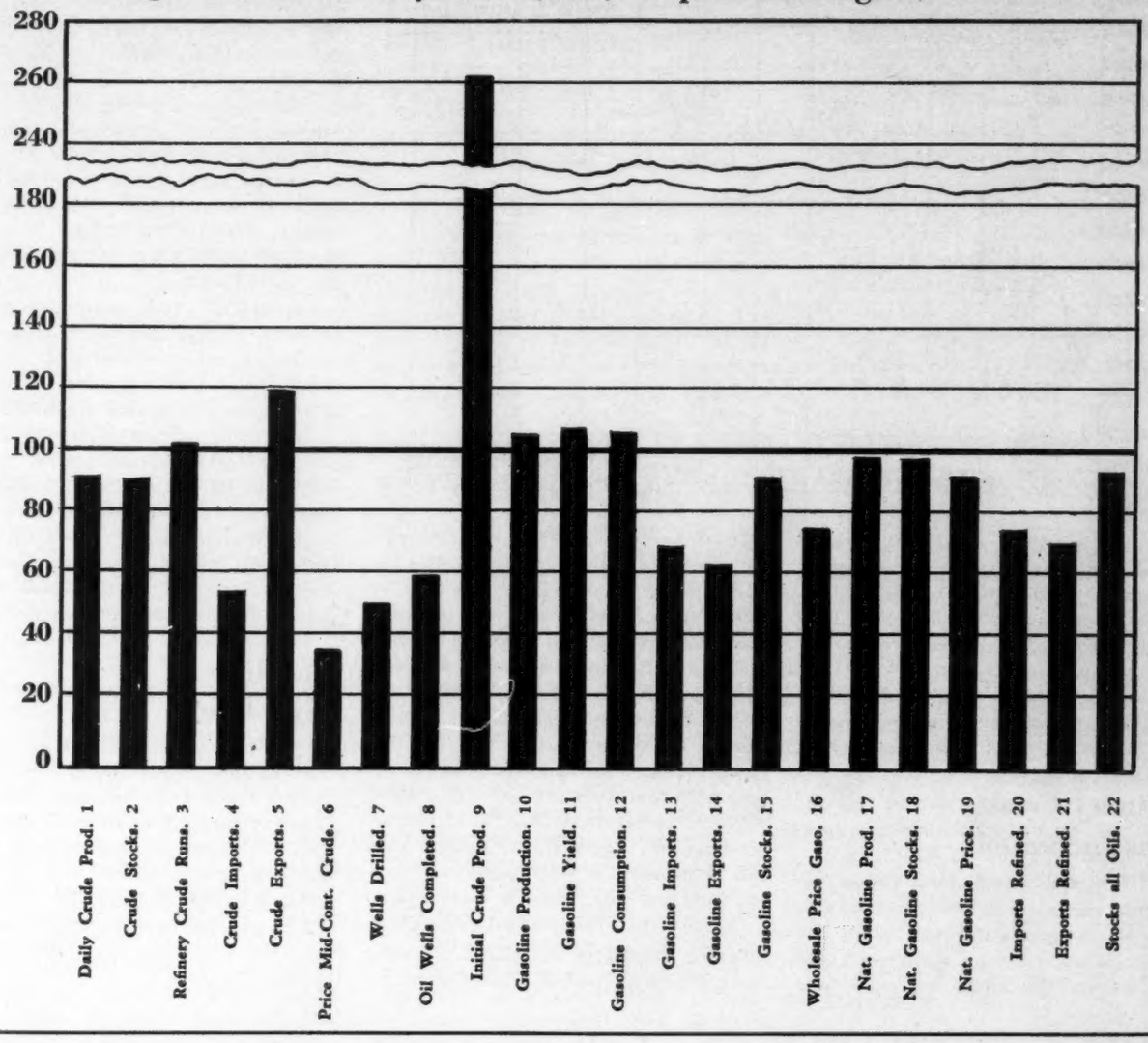
STOCKS of all oils in the United States showed a net decline during August of close to 16,000,000 barrels. This represents the largest monthly withdrawal ever made from storage. The daily average new supply of all oil during August totaled 2,314,000 barrels, whereas the daily average indicated domestic demand for all oil was 2,648,000 barrels. This indicates an approximate deficiency in August of 324,000 barrels daily. Stocks of crude oil on August 31 amounted to 476,135,000 barrels, compared with 489,935,000 barrels on July 31. This was a decline of nearly 14,000,000 barrels, reflecting the enforced shut-down in Oklahoma and partially reflecting the subsequent establishment of martial law in East Texas. An even larger withdrawal from stocks is expected to be shown for September, since the full effect of the shut-down in East Texas will be reflected in the figures for that month.

Gasoline Demand

DOMESTIC gasoline demand during August was at exactly the same rate as in July; 39,459,000 barrels, a daily average of 1,273,000 barrels. Total consumption for that month amounted to 43,669,000 barrels, whereas total supply, production plus im-



Salient Oil Industry Factors for August, 1931, Expressed in Per Cent of August, 1930. Heavy Line (100) Represents August, 1930

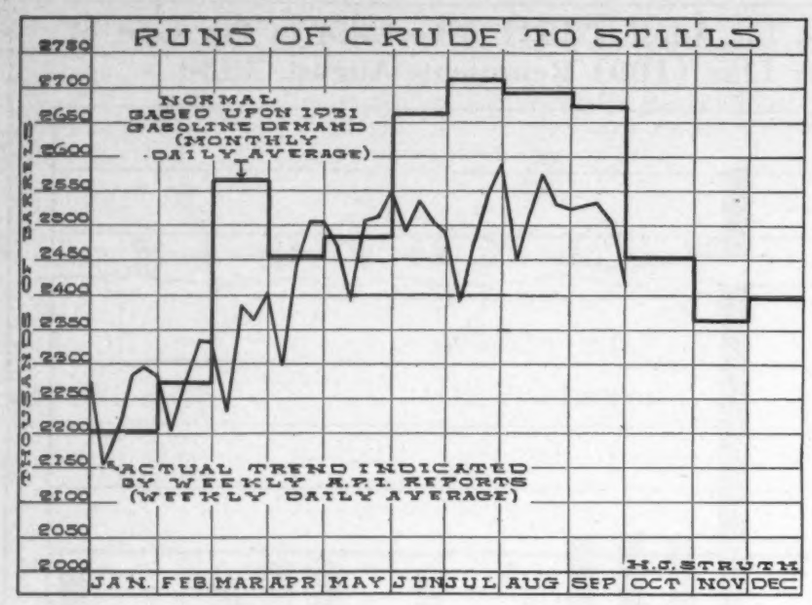


Oil Industry Barometer—August, 1931

Index of Salient Factors—Current and Cumulative

Factors—	This Month			8 Months Ending Aug. 31		
	Last Year	This Year	Index (1)	Last Year	This Year	Index (1)
1 Daily Average Crude Production (Thous. Bbls.)	2,414	2,207	91	2,547	2,337	92
2 Total Crude Stocks (Thous. Bbls.).....	526,785	476,135	90	526,785	476,135	90
3 Refinery Crude Runs (Thou. Bbls.).....	79,289	80,672	102	635,590	598,765	94
4 Crude Imports (Thous. Bbls.).....	5,059	2,702	53	42,066	31,799	76
5 Crude Exports (Thous. Bbls.).....	2,407	2,867	119	16,473	17,341	105
6 Posted Price 36 Grav. Mid-Cont. Crude (Per Bbl.) (2)	$1.29	$.44	34	$1.29	$.59	46
7 Wells Drilled*	1,837	899	49	14,260	7,497	53
8 Oil Wells Completed*	930	545	59	8,012	3,904	49
9 Initial Crude Production (Thous. Bbls.)*	1,160	3,032	261	6,476	15,645	242
10 Gasoline Production (Thous. Bbls.).....	37,844	39,283	104	298,415	289,649	97
11 Gasoline Yield—Average Per Cent of Crude (4).....	42.12	44.48	106	41.66	43.70	105
12 Domestic Gasoline Consumption (Thous. Bbls.).....	37,433	39,459	105	264,829	270,423	102
13 Gasoline Imports (Thous. Bbls.).....	1,827	1,244	68	11,726	9,805	84
14 Gasoline Exports (Thous. Bbls.).....	6,691	4,210	63	47,149	32,582	69
15 Gasoline Stocks at Refineries (Thous. Bbls.).....	41,424	37,190	90	41,424	37,190	90
16 Refinery Price U. S. Motor Gaso.—Group 3 (Cents)..	6⅜	4¾	[3]74	6¾	3⅝	[3]54
17 Natural Gasoline Production (Thous. Bbls.)	3,286	3,179	97	35,486	29,678	84
18 Natural Gasoline Stocks (Thous. Bbls.).....	744	722	97	744	722	97
19 Price Grade "A" Natural Gasoline, Group 3 (Cents)	5½	5	[3]91	5⅝	3	[3]53
20 Imports of All Refined Oils (Thou. Bbls).....	4,329	3,224	74	29,958	25,943	87
21 Exports of All Refined Oils (Thous. Bbls.).....	12,563	8,713	69	94,738	68,926	73
22 Total Stocks of All Oils (Thous. Bbls.).....	686,831	633,218	92	686,831	633,218	92
Weighted Index of Supply	.....	.....	102	.....	.....	103
Weighted Index of Demand.....	.....	.....	91	.....	.....	89
Weighted Index of Prices.....	.....	.....	66	.....	.....	51

*Exclusive of Rocky Mountains. (1)—Last Year—100.
(2)—Weighted Average. (3)—Monthly Average.
(4)—Straight run and cracked gasoline only.



ports, amounted to 40,527,000 barrels. Cumulative consumption of gasoline in the United States for the first eight months of this year amounted to 270,423,000 barrels, an increase over the same period of last year of 5,594,000 barrels. Exports of gasoline, however, declined under the same period of last year to the extent of 14,567,000 barrels.

Refinery Crude Runs Increased

RUNS to stills at refineries during August increased 29,000 barrels a day, according to figures released by the Bureau of Mines. During that month, the daily average throughput of crude was 2,602,000 barrels. However, the report of the American Petroleum Institute for the week ending October 3, showed that the rate of throughput, on a Bureau of Mines basis, had declined to 2,360,000 barrels. As a result of this curtailment, stocks of gasoline had been reduced on October 3 to a total of 30,368,000 barrels. On a Bureau of Mines basis, this means that gasoline stocks on October 3 probably aggregated about 33,951,000 barrels, or about 3,239,000 barrels less than was reported on hand on August 31. If runs to stills can be maintained at or below the present indicated rate, there is every reason to believe that refiners will succeed in attaining the degree of balance necessary to an improved gasoline market structure.

Imports and Exports

IMPORTS of petroleum and its products during August showed a decline under imports for July. Crude imports amounted to 2,702,000 barrels, against 3,588,000 barrels in July, while refined oil imports amounted to 3,224,000 barrels, against 3,435,000 barrels in July. The cumulative total for this year to August 31 shows crude imports amounting to 31,799,000 barrels, against 42,066,000 barrels in 1930 and refined oil imports of 25,943,000 barrels, against 29,958,000 barrels in 1930.

Exports of crude petroleum and its products during August showed an increase for crude oil and a decrease for refined oils. Crude exports amounted to 2,867,000 barrels, against 2,621,000 barrels in July, while refined oil exports amounted to 8,713,000 barrels, against 9,135,000 barrels in July. Cumulative total for the year to date shows crude exports at 17,341,000 barrels, against 16,473,000 barrels last year. Refined oil exports during this period amounted to 68,926,000 barrels, against 94,738,000 barrels last year.

Gasoline by Pipe Line

MOVEMENT of gasoline by pipe lines in the United States continues to show a tendency to increase. Bureau of Mines figures for August show that 1,827,000 barrels of gasoline was turned into pipe lines, compared with a total of 1,410,000 barrels in July. The total quantity of gasoline moved by pipe lines since the first of this year amounts to 6,908,000 barrels.

Crude Runs to Stills, Gasoline Stocks and Gas and Fuel Oil Stocks

Week Ending September 26, 1931
(Figures in barrels of 42 gallons)

District	Potential Capacity (Daily) Total	Potential Capacity (Daily) Reporting	Potential Capacity (Daily) Per Cent	Crude Runs to Stills Total	Crude Runs to Stills Daily Average	Crude Runs to Stills Per c't Operated	Gasoline Stocks (see note below)	Gas & Fuel Oil Stocks
East Coast	633,700	633,700	100.0	3,493,000	499,000	78.7	3,702,000	10,821,000
Appalachian	149,600	137,400	91.8	730,000	104,300	75.9	1,260,000	1,604,000
Ind., Ill., Ky.	436,300	431,500	98.9	2,269,000	324,200	75.1	3,786,000	4,975,000
Okla., Kans., Mo.	485,700	435,200	89.6	1,744,000	249,100	57.2	2,793,000	5,127,000
Texas	838,200	765,400	91.3	3,655,000	522,100	68.2	5,342,000	11,514,000
Louisiana-Arkansas	233,100	230,500	98.9	1,156,000	165,100	71.6	833,000	3,458,000
Rocky Mountain	159,400	142,300	89.3	391,000	55,900	39.3	1,213,000	808,000
California	912,500	880,100	96.5	3,051,000	435,900	49.5	*11,844,000	97,513,000
Total week Sept. 26	3,848,500	3,656,100	95.0	16,489,000	2,355,600	64.4	30,773,000	135,820,000
Total week Sept. 19	3,848,500	3,656,100	95.0	17,022,000	2,431,700	66.5	31,123,000	135,133,000
Total week Sept. 12	3,848,500	3,656,100	95.0	17,219,000	2,459,900	67.3	31,818,000	135,374,000
Total week Sept. 5	3,848,500	3,656,100	95.0	17,194,000	2,456,300	67.2	31,184,000	135,330,000
Total week Aug. 29	3,848,500	3,656,100	95.0	17,171,000	2,453,000	67.1	33,215,000	134,885,000
Total Sept. 27, 1930	3,686,400	3,525,400	95.6	17,512,000	2,501,700	71.0	(a)35,571,000	140,779,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.								
Texas Gulf Coast	532,500	531,500	99.8	2,757,000	393,900	74.1	4,133,000	8,155,000
Louisiana Gulf Coast	147,500	147,500	100.0	786,000	112,300	76.1	586,000	2,495,000

Note: In all the refining districts indicated except California, figures in this column represent gasoline stocks at refineries. In *California, they represent the total inventory of finished gasoline and engine distillate held by reporting companies wherever located within continental United States—(stocks at refineries, water terminals and all sales distributing stations, including products in transit thereto).

(a) Revised in Indiana-Illinois district, due to transfer to "Bulk Terminals" of stocks previously reported as "At Refineries".

▼ TECHNOLOGY ▼

Natural Gasoline

NATURAL gasoline production declined during August to 3,179,000 barrels, compared with 3,521,000 barrels in July. Total production since January 1 has shown a decline under the same period of last year of 5,808,000 barrels. Cumulative production for this year amounted to 29,678,000 barrels, against 35,486,000 barrels last year. Stocks of natural gasoline during August showed a decrease of 557,000 barrels, compared with a decrease in July which amounted to 220,000 barrels. Since the first of this year, natural gasoline stocks have shown a net decline of 79,000 barrels.

Utilization of Acid Sludge

BOTH production and consumption of acid sludge at petroleum refineries increased in 1930, according to a canvass just completed by the United States Bureau of Mines. The gain in the use of this material as a refinery fuel was greater than the increase in output, indicating a tendency towards more complete utilization. It is estimated that four per cent of the total heat units utilized at oil refineries is now supplied through the burning of acid sludge. While this percentage indicates that acid sludge is only of minor importance as a refinery fuel, many refiners have found it economical to install the special burners necessary to handle this material. These refiners not only effect a saving through the heat units obtained, but are enabled to dispose of a waste product, which in the past has generally been regarded as a necessary evil and dumped into pits.

Technical Paper Deals With Lubricating Oils

THOSE interested in the study of lubricating oil and engine performance will find Bureau of Mines Technical Paper, No. 500, "Relationship Between Volatility and Consumption of Lubricating Oils in Internal-Combustion Engines," of interest and value. This 52-page booklet represents a painstaking study of the subject by its authors, Gustav Wade and A. L. Foster. It can be secured from the Superintendent of Documents, Washington, D. C., price 10 cents.

Papers Deal With Hydrogenation

THE Third International Conference on Bituminous Coal to be held at Pittsburgh, November 16 to 21, will include a number of papers dealing with hydrogenation, which will prove of interest to the refining industry. Dr. Thomas S. Baker, president of Carnegie Institute of Technology, where the sessoins will be held, includes the following papers on the subject of hydrogenation in his announcement of the tentative program:

"Early History of Hydrogenation," by Dr. Friedrich Bergius, Germany.

"The Dispersion of Coal in a Liquid Medium," by Prof. A. Gillet, Belgium.

"Further Investigations of the Action of Hydrogen upon Coal," by J. Ivon Graham and D. G. Skinner, England.

"Catalysts in Hydrogenation Cracking," by Andre Kling and Daniel Florentin, France.

"Catalysts for High Pressure Reduction and Hydrogenation of Phenols and Hydrocarbons," by Dr. Hans Tropsch, Czechoslovakia.

"Synthesis of Lubricating Oils from Coal and Its Gaseous Products," by Prof. A. W. Nash, England.

"The Simultaneous Cracking, Carbonization and Gasification of Coal and Oils," by G. Eggloff and A. Fisher, United States.

"The Formation and Combustion of Hydrocarbons," by Prof. Dr. E. Berl, Germany.

"The Interrelationships of Coal, Petroleum and Natural Gas," by Dr. W. T. Thom, Jr., United States.

Tentative Standard Analysis Method

THE California Natural Gasoline Association has published "Tentative Standard Method for Analysis of Natural Gasoline by Fractional Distillation" and the booklet is ready for distribution at the price of $1.00 per copy. The method was recommended by the fundamental analysis committee of the California Natural Gasoline Association and adopted by vote of the members at the general meeting held in Los Angeles, June 25, 1931. Copies may be secured by writing the association at 314 Paramount building, 323 West 6 Street, Los Angeles, Wallace McIlhaney, secretary.

Hydrogen Sulphide

THE Bureau of Mines, Washington, D. C., has issued Report of Investigation No. 3128 "Hydrogen Sulphide Content of the Gas in Some Producing Oil Fields," by John M. Devine and C. J. Wilhelm. The bulletin contains analyses of 102 samples of petroleum from a large number of producing fields in the United States. Copies may be secured from the Section of Publications, Bureau of Mines at no cost.

Dye Cheaper Than Chemicals

"DYE Saves Dollars in Treating Gasoline," is the title of a booklet just put out by Universal Oil Products Company, Chicago. The authors of the booklet are Gustav Egloff, J. C. Morrell, and Paul Truesdell. Copies of this booklet may be obtained free by addressing Universal Oil Products Company, 310 S. Michigan Avenue, Chicago, and asking for U. O. P. booklet No. 99.

Cracked Gasoline Production

Week Ending September 26, 1931
(Barrels of 42 gallons)

District	Potential Cracking Capacity Daily Reporting Total	Daily Reporting Per Cent	Total	Production Daily Average
East Coast	261,300	90.4	657,000	93,900
Appalachian	56,300	96.1	182,000	26,000
Indiana, Illinois, Kentucky	330,400	95.5	546,000	78,000
Oklahoma, Kansas, Missouri	237,800	92.3	432,000	61,700
Texas	450,800	96.8	947,000	135,300
Louisiana-Arkansas	112,400	100.0	225,000	32,100
Rocky Mountain	99,100	98.5	93,000	13,300
California	190,800	100.0	272,000	38,800
Total week Sept. 26	1,738,900	95.6	3,354,000	479,100
Total week Sept. 19	1,738,900	95.6	3,389,000	484,200
Total week Sept. 12	do	do	3,563,000	509,000
Total week Sept. 5	do	do	3,376,000	482,000
Total week Aug. 29	do	do	3,428,000	489,700
Total Sept. 27, 1930	1,589,200	83.6	2,751,000	393,000
The Texas and Louisiana Gulf Coastal Figures Shown Below are included above in the totals of their respective districts.				
Texas Gulf Coast	352,400	98.6	769,000	109,900
Louisiana Gulf Coast	77,000	100.0	163,000	23,300

▼ ASSOCIATION ACTIVITIES ▼

A. P. I. Division of Refining Program

UNITED States Secretary of Commerce Robert P. Lamont will be the guest speaker at the annual dinner of the American Petroleum Institute to be held in the Stevens Hotel, Chicago, Wednesday evening, November 11. The subject of Secretary Lamont's address has not been announced.

The annual meeting, which formally opens Tuesday morning, November 10, will be given over largely to general and group sessions of the Institute's divisions of production, refining and marketing this year, much of the technical work done by committees having been completed at mid-year sessions of the divisions.

An Institute general session will be held Tuesday afternoon, November 10. Speakers will be Oscar Sutro, Standard Oil Company of California, who will discuss "The Anti-trust Laws and the Natural Resource Industries;" Colonel J. Lewis Thompson of Kilgore, Texas, whose subject will be "East Texas and East Texans," and E. B. Reeser, Barnsdall Oil Corporation, Tulsa, who as president of the Institute, will deliver the "President's Address."

At the general session of the division of refining, scheduled for Thursday afternoon, November 12, statistical surveys and economic forecasts of the refining situation for 1931 will be presented by committees representing the Institute and the Federal Oil Conservation Board, and speakers will discuss aviation problems and the place and results of research in industry.

The mornings of Wednesday, November 11, and Thursday, November 12, will be given over to group sessions of the three divisions. The division of refining group will discuss motor fuel and on Thursday the division of refining will consider lubricants.

The program to be presented at the sessions of the Division of Refining follows:

Wednesday Morning, November 11

(North Ball Room)

General Topic: Motor Fuel.

"Permissible Vapor Pressures in 1931 Cars," by O. C. Bridgeman, U. S. Bureau of Standards.

"Co-operative Fuel Research Apparatus and method for Knock-Testing," by T. A. Boyd, General Motors Corporation, chairman, Detonation Sub-committee.

"Some Observations on Automotive Fuel Requirements," by J. A. C. Warner, Society of Automotive Engineers.

Thursday Morning, November 12

(North Ball Room)

General Topic: Lubricants.

"Extreme-Pressure Lubricants," by H. C. Mougey and J. O. Almen, General Motors Corporation.

"Improved Paraffin Base Lubricants," by G. H. B. Davis, Standard Oil Company of Louisiana, and A. J. Blackwood, Standard Oil Development Company.

Report of Division's Nominating Committee, C. L. Henderson, Vickers Petroleum Company, chairman.

Election of twenty members of the general committee of the Division of Refining.

Thursday Afternoon, November 12

General Session: Refining.

Report of the acting chairman of the Division of Refining, W. R. Boyd, Jr., American Petroleum Institute.

"A Statistical Survey and Economic Forecast of the Refining Situation," by Oliver S. Ambrose, Tide Water Oil Company (for the Institute's committee on refinery statistics and economics), E. B. Swanson, U. S. Bureau of Mines (for the Federal Oil Conservation Board.)

Aviation Problems. (Speaker to be announced.)

"The Place of Research in Iudustry," by Frank B. Jewett, American Telephone and Telegraph Company.

"Dividends from A. P. I. Fundamental Research Program," by J. Bennett Hill, Atlantic Refining Company.

Changes in Membership Of Institute Committees

ANNOUNCEMENT has been made of recent changes in the personnel of American Petroleum Institute committees.

D. P. Barnard, Standard Oil Company (Indiana), Whiting, Indiana, has succeeded R. E. Wilson, of the same company, as a member of the committee on motor fuel research.

L. Mittelman, Associated Oil Company, Los Angeles, has succeeded O. P. Cottrell, of the same company, as a member of the committee on testing methods and specifications.

F. W. Sullivan, Standard Oil Company (Indiana), Whiting, Indiana, has succeeded F. M. Rogers, of the same company, on the committee on composition and properties of petroleum.

R. C. Powell, The Texas Company, New York, has succeeded M. Halpern, of the same company, on the sub-committee on Unfired pressure vessels, a unit of the committee on standardization of refinery equipment.

▼ S A F E T Y ▼

Safety in Cracking Still Operation

"HOW to Safeguard Cracking Operations From Accident," by E. M. Matson, has just been put out in booklet form, reprinted from Refiner and Natural Gasoline Manufacturer. Mr. Matson has had many years experience in design, construction and operation of cracking units and is now in charge of inspection services rendered to Dubbs licensees by Universal Oil Products Company. Copies of this booklet may be secured free by writing to Universal Oil Products Company, 310 S. Michigan Avenue, asking for U. O. P. booklet No. 98.

First Manual of Series On Accident Prevention

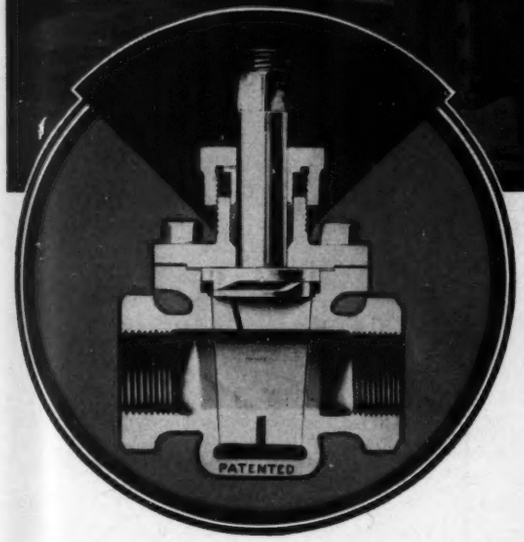
"A. P. I. MANUAL on Cleaning Petroleum Storage Tanks," the first of a series of manuals on accident prevention, has been published by the American Petroleum Institute.

It represents the work of the Institute's committee on accident prevention in refineries and department of accident prevention in co-operation with representatives of oil companies throughout the country. A feature is the series of recommended safe practices based upon the experiences of companies whose representatives aided in the work.

The manual, in 12 pages and punched to fit the standard three-ring binder, was prepared for the use of executives, superintendents and foremen responsible for issuing instructions to guide workers engaged in cleaning petroleum storage tanks. It presents in convenient form, with illustrations, information designed to promote the safety of such workers, covering sources of accidents, causes of explosions or fires, causes of asphyxiation, other causes of accidental injury, typical cleaning methods and equipment, etc.

The foreword states that the manual is not to be confused with federal, state or insurance requirements, al-

Where Quick, Positive Valve Action Is Required . . . Use Homestead



These advantages of the Homestead Quarter-Turn Valve mean Longer, Continuous, drop-tight service with lower maintenance costs:

Individually fitted plug
Protected Seating Surfaces
Positive Seating Action
Sealed bottom and bonnet
Stem packed
Instantaneous operation
Rugged Construction

Now, more than ever before, it is important that you keep your operating costs as low as possible by buying valves which save your operators time thru their quick operation, and save costly fluids by means of their positive-acting, metal to metal seat against leakage.

Homestead Valves afford their users these advantages by putting a positive stop to leakage, and giving the same low-cost, instantaneous service day after day, without attention.

Each Homestead Quarter-Turn Valve is cast in metals suitable for the pressure, temperature, and fluid conditions under which they are to be used, so that they give the same low-cost service under each set of working conditions. For instance the user represented by the photograph is profiting from the advantages of thirty, size three inch Homestead Valves on alcohol lines.

Apply the merits of Homestead Quarter-Turn Valves to your refinery for handling hot oil, vapors, tars, air, steam, water, gas, etc. Tell us about your service conditions and we'll gladly recommend the proper valve for your needs.

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LIME AND OIL
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ALL LIQUID CHEMICALS

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though it is in general accord with their intent and spirit.

Twenty-eight additional accident prevention manuals are in course of preparation by the committee on accident prevention in refineries, in production and in marketing. These cover welding, dewaxing, loading tank cars, treating, natural gasoline plants, laboratories, rotary drilling, pipe laying, truck and tractor driving, miscellaneous field work, handling package goods, service station operation, etc.

Copies of "A. P. I. Accident Prevention Manual Number 1" are available at 25 cents each, with discount for quantities, from American Petroleum Institute headquarters, New York, of the Department of Accident Prevention, 1508 Kirby building, Dallas, Texas.

Mid-Continent Safety Council Separate Group

THE Mid-Continent Petroleum Safety Council began functioning as a separate group July 1, after the Mid-Continent Oil & Gas Association withdrew its sponsorship and financial aid because of the association's retrenchment program. Don J. Wallace who has been managing director of the safety section of the association for the past four years has been organizing the work under a separate association for several weeks. The new association or council has headquarters on the sixth floor of the Daniels building. Gulf Coast, north Texas, Kansas-Oklahoma chapters of the Petroleum Safety Council have all adopted resolutions urging support and continuation of the activities of Mid-Continent Safety Council.

Good Practice Code For Pressure Vessels

PLANS have been made for organization of a joint committee representing the American Petroleum Institute and the American Society of Mechanical Engineers to be entrusted with the work of preparing a code of good practice in the design and construction of unfired pressure vessels for flammable liquids and gases. The code would cover vessels used in cracking oils.

Progress already has been made by the Institute's committee on standardization of refinery equipment, through the intensive efforts of Pacific Coast members, in developing the tentative draft of such a code.

The plan to set up the joint committee was developed as an alternative, for the present at least, to the proposal to request the establishment of a sectional committee on this topic by the American Standards Association.

PERSONALS

Field Elected by Gasoline Association

O. C. FIELD, president, O. C. Field Gasoline Corporation, Los Angeles, has been elected vice president of the Natural Gasoline Association of America. His selection was made by directors of the organization, following the resignation of W. W. Robinson, Jr., The Texas Company of California. Mr. Robinson resigned because of his transfer from the California territory to New York.

O. C. FIELD

Mr. Field is president of the California Natural Gasoline Association and is active in association activities on the West Coast.

Correa Elected to Directorate

WILLIAM H. CORREA manager industrial lubricating department Standard Oil Company of New York was recently elected a member of the board of directors. Mr. Correa entered the employ of his company in 1908 as master mechanic at the Pratt works, Long Island City. He has served in various capacities in all of the company's East River refineries and in 1918 became superintendent of the East Providence works after building the plant there. After serving as technical expert in the Far East he was transferred to the Levant division with headquarters at Constantinople, to return finally to New York City as manager of the industrial lubricating department.

Phillip Drake Dies

PHILLIPS L. DRAKE, superintendent of the West Tulsa refinery for The Texas Company for the past several years, died suddenly September 5 at Austin, Texas, where he was visiting relatives. Mr. Drake had been in the employ of The Texas Company for 19 years. He had been in charge of the Tulsa works since 1926.

Clayden Moves To Detroit

A. LUDLOW CLAYDEN, research engineer for Sun Oil Company, has moved his headquarters to the First National Bank building, Detroit, Michigan, from Philadelphia, in order to be in closer contact with the automotive industry. Mr. Clayden's work consists mainly of development of new fuels and lubricants to meet the constantly changing demands of the automobile industry.

C. W. Suhr Killed In Airplane Wreck

CHARLES W. SUHR, son of Charles L. Suhr, president the Pennzoil Company, Oil City, Pennsylvania, was killed in an airplane accident near Kansas City, September 22. Mr. Suhr was making a hurried trip to the West Coast, where he lived at Los Angeles.

Johnson to Texas City

E. A. JOHNSON, superintendent of Misko refineries for the past 4½ years, has resigned his position and moved to Texas City, Texas, where he has formed a connection with Stone Oil Company of Houston. G. W. Estes has been made superintendent of the Misko Refineries, Inc., Mirando City, Texas.

Dr. Born Accepts Tulsa U. Professorship

DR. SIDNEY BORN has accepted the professorship of petroleum research in the University of Tulsa and began his duties with the opening of the 1931 school year. In addition he will engage in a general consulting practice and will maintain his consultation office at the University.

Dr. Born resigned as assistant superintendent of refineries of the Marathon Oil Company in Tulsa September 1, 1931.

After being graduated from Columbia University with degrees of Bachelor of Science and Doctor of Philosophy, Dr. Born joined Rittman Process Corporation as chief chemist. While in that position he assisted in the development of several well known cracking processes, especially vapor phase cracking.

His first connection with the petroleum industry was as chief chemist of Empire Refineries, Inc., and associated companies in 1916. During the war he was a consulting engineer for the United States Bureau of Mines and assisted in the design of furnaces for the production of war materials. He was with the Empire

DR. SIDNEY BORN

organization until 1920, when he became assistant superintendent of refineries of Transcontinental Oil Company, whcih in 1930 was bought by Ohio Oil Company and its name changed to Marathon Oil Company.

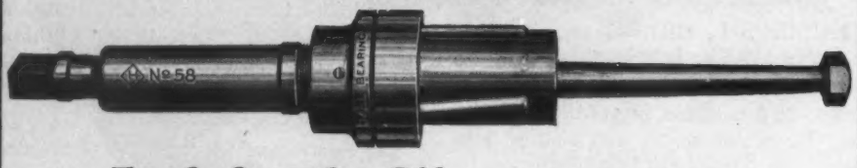
Dr. Born also is the inventor of several cracking process operations as well as the holder of patents on the synthesis of alcohol and various compounds from petroleum.

He is a Sigma Xi and Phi Lambda Upsilon; a member of the Chemists' Club of New York. He was the first counsellor for the Oklahoma section of the American Chemical Society.

New Publicity Director for A. P. I.

HARRY BENGE CROZIER, Dallas, Texas, has been appointed director of the American Petroleum Institute's Department of Public Relations. He succeeds Leonard M. Fanning, who resigned to enter the publishing business after three years as director of the department and previous

Heavy Duty Expanders for Still Tubes



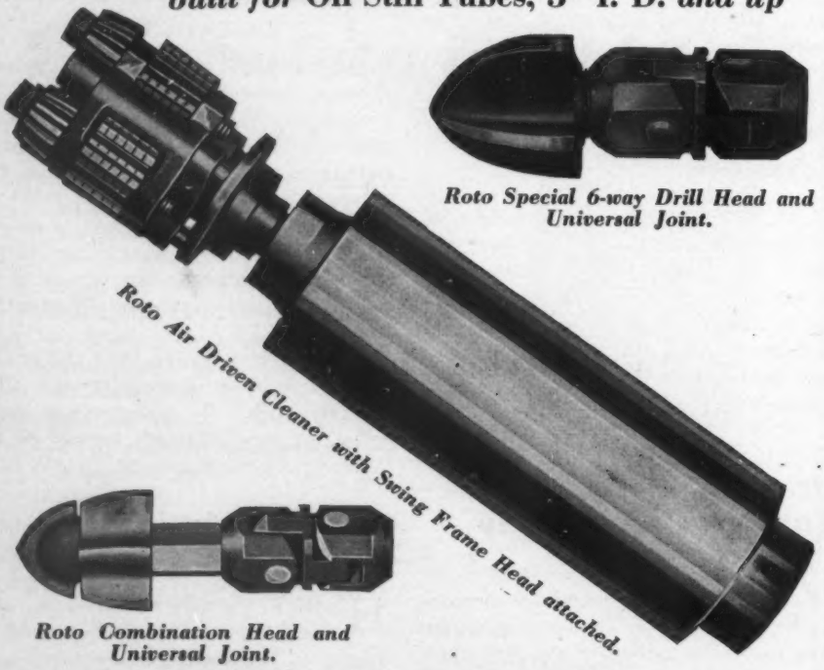
Tools for the Oil Industries

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches

A. L. HENDERER'S SONS
Wilmington, Del.
Established 1870
Expanders since 1884

ROTO TUBE CLEANERS

built for Oil Still Tubes, 3″ I. D. *and up*



Roto Special 6-way Drill Head and Universal Joint.

Roto Air Driven Cleaner with Swing Frame Head attached.

Roto Combination Head and Universal Joint.

THE ROTO COMPANY
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service with the Institute's Depar'ment of Statistics.

Mr. Crozier, who assumed his new duties September 28, has been engaged in newspaper, magazine and public relations work in the Southwest since 1913. From 1913 until he entered the army in 1918 he was on the staff of the Galveston-Dallas News, and upon his return to civil life joined the staff of the Dallas News, serving as reporter, city editor and staff correspondent.

In 1924 he aided in organizing initial efforts to formulate plans for the Texas Centennial Celebration, to be held in 1936. For several years he was editor of "The Cattleman" and public relations counsel for the Texas and Southwestern Cattle Raisers' Association. He returned to Dallas News staff late in 1928.

Since 1913 Mr. Crozier has covered, as a newspaper correspondent, all ses-

—Blank Stoller

H. B. CROZIER

sions of the Texas legislature with the exception of those during the war. He has also observed and written of the discovery and development of all new Texas oil fields during the past decade. A native of Paint Rock, Texas, he is married and has one son. His family will join him shortly in New York.

Mr. Fanning, former director of the department, now is engaged in editing and publishing at Room 440, 122 East 42nd Street, New York, a new petroleum reference annual and buyers' guide to be known as the "Petroleum Code Handbook." It will register marketers, jobbers and dealers in petroleum products in all states and is designed for serviceable use by sales executives, owners and operators of service stations. It will contain also considerable material on the Code of Marketing Practices and on Code Committee personnel and work.

To give better service to the Eastern trade, we have opened an office at 117 Liberty Street, New York City, under the direction of Mr. O. F. Kluenter.

With the present low price of petroleum products, efficiency in the refining of these products is the watchword. To gain this efficiency you must have first of all, proper fuel burning equipment, and secondly, proper regulation. To give the highest fuel efficiency we manufacture the Webster Radiant Regenerative Gas Burner with adjustable orifice which compensates for varying B. T. U. contents of gas instantly, with the regenerative feature preheating the gas, which allows a regulation of flame lengths to fit all conditions. In regulation we distribute the Pioneer of Regulators, "Wilgus." With the above combination we are able to give the highest efficiency possible, along with the well known "Webster Service." Send us your problems.

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THE FIGHT *against* CORROSION

The fight is always on against Corrosion, the ever-present enemy of refining equipment. Invincible in the battle are Duriron Company's *corrosion-resistant* products. Call on them now for the protection of your plant.

Certainly if you have *special corrosion problems* you will want to find out what our *special* alloy steel castings can do for you.

These castings are of Durimet, a high nickel-chromium-silicon steel which we developed—also of Durco Nirosta and Special Analysis Alloys—all expertly produced in our induction furnaces.

All are made specifically for special requirements. Every step is strictly under laboratory control, insuring *dependable resistance* to corrosion, heat and pressure.

Perhaps this will solve one of your pet troubles. At least, it's worth writing us for booklet, "Alloy Steel Castings," which contains valuable data.

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Special alloy steel castings made by The Duriron Company may be produced in a great variety of forms. Intricate designs are entirely practicable. In widely differentiated industries they are reducing corrosion costs every day.

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That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request

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Wotowitch Heads Fuel Committee

R. A. WOTOWITCH, Cities Service Company, was elected chairman of the executive committee on fuels and lubricants at the recent meeting of the Aeronautical Chamber of Commerce. Other members of the committee are Major E. E. Allen, Standard Oil Company of New Jersey; G. French, Sinclair Refining Company; A. L. Beale, Vacuum Oil Company; F. Shipman, The Texas Company; R. H. McLaren, Gulf Refining Company, and Fred Foster, Richfield Oil Company.

D. G. Gray, Manager Waggoner Refining

D. G. GRAY has been appointed manager of the Waggoner Refining Company, operating a refinery at Electra, Texas, following his resignation as president and manager of Dale Oil and Refining Company. John E. Kilgore, attorney, Wichita Falls, Texas, succeeds Mr. Gray as president of the Dale company and J. D. Dale was appointed manager of the same concern.

A. M. EDMISTON

Edmiston Keeping Men on the Pay Roll

A. M. EDMISTON, the man in the picture, began his career in the oil business in Erie, Kansas, back in 1905 with Great Western Refining Company. After working there for some time, other fields called him, and the refineries of various sections of the country saw him on the pay roll. About 10 years ago, he decided that the grease and lubricating business

would be a good thing, and went back to Erie to build and operate a plant of his own. Cameron Refining Company, now Wirt Franklin Petroleum Corporation was being organized, and his services were secured to build and operate its refinery.

His ideas on political economy are quite interesting, and he is doing all in his power to keep men on the payroll in order to help out the present unemployment.

"Petroleum Facts and Figures"

"PETROLEUM Facts and Figures," a year book of the petroleum industry, has been published in a fourth edition by the American Petroleum Institute.

Several new sections appear in the 268-page volume. These cover price records of crude and refined petroleum products, production and utilization of asphalt and state taxation of gasoline. A feature of the book is a two-page chart showing the trend of prices for 36-gravity Mid-Continent crude oil and service station prices of gasoline from 1924 to 1931. Established features of previous editions are reprinted with modifications which bring them up to date. The price of the fourth edition is $2.

PLANT ACTIVITIES

ACTIVITY in the manufacturing branch of the petroleum industry continues to be directed toward expansion of facilities, especially the installation of improved processes of utility in the manufacture of high anti-knock quality gasolines. Lubricating oil manufacturers are continuing their adoption of direct ammonia expansion refrigeration systems for use in the manufacture of low pour test motor lubricating oils.

Construction activity continues in practically every refining district of this country and Canada. Natural gasoline plant construction has been enlivened by the construction of gasoline plants in the East Texas field and the proposal of several more installations. Some natural gasoline plant construction and enlargement is also noted in California.

Refiners in the Eastern, Appalachian, and Central States districts especially are becoming more interested in the erection of gasoline reforming units, and additional companies are reported carrying out programs of installation of this sort of equipment. The demand for premium motor fuels in the more populous sections of the country has made necessary the utilization of such facilities.

Several more refineries entered the operating lists, although most of them are small. A few new plants are building and a few more proposed. The greater part of the activities evidenced by current reports may be attributed to the fact that refiners are going over their plants, replacing worn equipment, improving processes, and the like, in preparation for the winter operations.

NEW PLANTS

Associated Oil Company has company has completed all test runs in its new tube and tank type cracking plant at the Avon, California, refinery and has placed the installation in general service. With a capacity of 10,000 barrels per day, the plant is the largest of its kind yet built.

California Refineries, Inc., has revived plans to build a small refinery for the manufacture of various lubricants, the plant to be located between Los Angeles and Alhambra. The company was originally organized to use a special vapor process, but no definite announcement has been made along this line. E. M. Buckins is president, E. Baden-Powell, vice president, and E. M. Holcomb, secretary and treasurer.

The Coastal Petroleum Corporation, A. T. & M. Railroad building, Mobile, Alabama, is erecting a 5700-barrel combination skimming and Pratt vapor phase cracking plant at Blakely Island, opposite the city of Mobile. Victor H. Smith, is president and treasurer of the company and C. C. Hand is vice president and secretary. Complete turnkey job was let to J. P. Devine Manufacturing Company, (affiliated with Automotive Distillate Corporation). Contract for tankage was let to Chicago Bridge & Iron Works. The plant is to be completed by December 15. Storage facilities for 200,000 barrels of crude will be provided. This is the second installation of the Pratt vapor phase cracking system, the first being operated by Lubrite Refining Corporation, East St. Louis, Illinois.

Community Refining Company has been formed to recondition and operate an old plant at Pawhuska, Oklahoma. George S. Cochrane, R. M. Sanders, C. E. Tate and Hugh M. Prather, all of Pawhuska, have formed the concern. The plant bought was formerly operated by Laurel Oil & Gas Company. It has been out of commission several years. When repaired it will run some 250 barrels of oil daily. Gasoline will be marketed within tank truck distance of Pawhuska.

Gulf Refining Company is making improvements at three of its Eastern refineries through the installation of a company - developed process called "gasoline drying process." Installation of this process, which is reported similar to gasoline reforming systems operated elsewhere, at the Toledo, Cincinnati and Pittsburgh refineries involves the expenditure of about $1,000,000. The company is reported to have spent approximately $6,000,000 during the past year in refinery construction and expansion in the three eastern cities mentioned.

Humble Oil & Refining Company is working on two gasoline plants of compression type, one in the Kilgore area and the other east of London, where the company holds a large block of producing acreage on which it already has numerous wells. The latter plant is nearing completion, foundations having been laid and machinery having been mounted upon them. This company is also reported considering erection of a third plant of this type. Along with extraction of the gasoline the company proposes to employ the residue gas for repressuring the Woodbine sand oil horizon, such work being made practicable in the London and Kilgore areas by virtue of the company holding large blocks of producing leases.

Indian State Oil Company is reported contemplating the erection of a skimming plant at Huntsville, Alabama. Cost is reported at $100,000. The same company owns a 1000-barrel skimming plant at Gladewater, Texas. Headquarters are given as Dallas, Texas. J. W. Sappington, representing the company has been in the Alabama city negotiating for a refinery site.

Imperial Oil, Ltd., plans installation of equipment at its Calgary refinery for the production of liquefied petroleum gases. The company has been negotiating with a number of smaller towns for the supplying of butane and propane, to be shipped in drums or tank cars.

Pan-American Petroleum & Transport Company, controlled by Standard Oil Company (Indiana), has purchased a 270-acre tract near Texas City and acquired pipe line right-of-way to nearby waterfront. This is in line with reports appearing in these columns over the past few months to the effect that this company or the parent company would erect a refinery in the Houston territory. No official confirmation, however, has been received from the company relative actual construction of a refinery on the newly purchased site.

Phillips Petroleum Company is scheduled to begin construction work immediately on a natural gasoline extraction plant, with initial capacity of 50,000 gallons daily, in the Sanchez Survey of the Longview district of the East Texas field. It will be so constructed that capacity can be increased at any time. The company is now engaged in making casinghead contracts with producers in the area around the plant site.

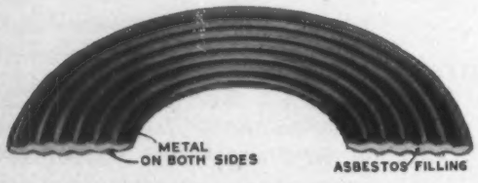
The above plant is one of a considerable number now building in the field or scheduled to be built. The natural gas from wells in the large East Texas field yields from three to five gallons of gasoline per 1000 cubic feet, this range representing net gasoline after weathering, and being the average for the whole field.

Rafineries Petroleras Nacionales de Mexico appears in reports as having been organized to develop a new hydrogenation process for the production of gasoline from Tuxpan crude. The process is based upon a Mexican patent issued September, 1930, but details are not available.

Sterling Oil Refineries, Ltd., is erecting a 1200-barrel tube still and fractionating columns type of refinery at Moose Jaw, Saskatchewan, Canada, to be placed in operation in November; cost is reported at $185,000. Don J. Baize, in charge of construction, will be operating superintendent; S. A. Hamilton is president of the company; James Pascoe and Hal Barrey are vice presidents; James Kennedy is secretary-treasurer; and L. D. Ohm is managing director. (Ref. & N. G. M. August, page 132, September, page 120).

Stanolind Oil & Gas Company, is reported proceeding with plans for a natural gasoline plant on the William Chisum Survey near Kilgore. Magnolia Petroleum Company was also reported contemplating construction of a plant of this type, but it was learned from a representative of the company that no plans have been made for such a project. Marine Corporation of Los Angeles and Dallas is said to be planning a natural gasoline extraction plant in the East Texas field, also; and another report credits similar plans to Roeser-Pendelton, Inc., Arkansas Fuel Oil Company, and Yount-Lee Oil Company, those three being reported as proposing joint construction of a plant in the Longview area, gas to be purchased from producing properties of the three companies and adjoining leases, and plans contemplating repressuring of the Woodbine formation with residue gas.

The Texas Company will build a new natural gasoline plant at Kettleman Hills, to replace the one destroyed by fire early in September. The loss has been placed at $500,000, all of which



METALLO
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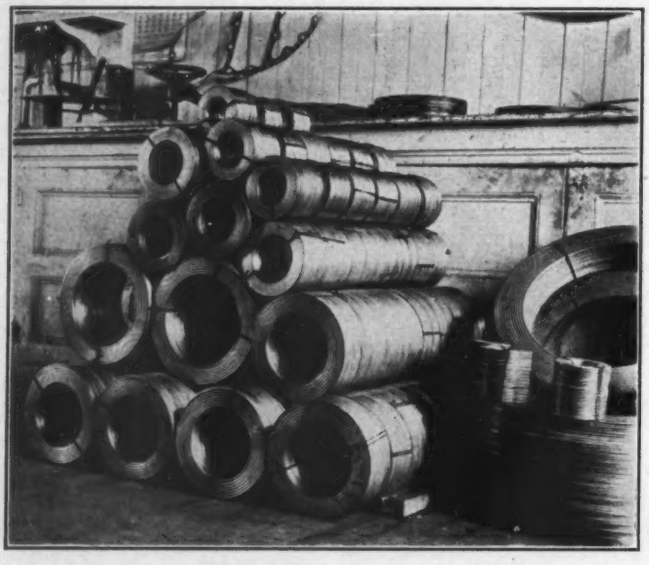
REFINERY TYPE
METAL-ASBESTOS
GASKETS



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Whether you use Dubbs, Cross, Tube and Tank, Jenkins or Lewis Cracking Process, you can rely implicity on Metallo Refinery Style 1000 Gaskets for all tongue and groove, male and female joints, and extra heavy flanges. Constructed with double jacket of corrugated Armco Iron, Steel, Monel Metal, Aluminum, Copper or Chromium Alloys, with filling of Asbestos, it is particularly adapted for any joints on cracking stills where pressures are up to 2,000 pounds, and temperatures up to 2,000 degrees Fahrenheit.

Write for Prices.

METALLO GASKET CO.
NEW BRUNSWICK — NEW JERSEY

was covered by insurance. A small fire broke out and spread during the night to gasoline stored near the plant. Weakness of equipment was in no way responsible for the fire. The plant was the first built at Kettleman Hills and was in service nearly three years.

Allegheny Refining Company, Bolivar, New York, has announced postponement of construction of a 1000-barrel completed refinery in that city, but stated that the project will again come up for consideration in November, or later this year.

▼ CHANGES ▼

Gilmore Oil Company, Los Angeles, was reported to be negotiating middle September for the acquisition of the 2500-barrel daily capacity skimming and asphalt plant formerly operated at Dayton, New Mexico, by State Oil & Refining Company. In the event the plans go through, the former would obtain its supply of crude from properties held by Geo. F. Getty Oil Company in eastern Eddy County, New Mexico, where a 22 gravity crude excellent for making road oil is available.

Howard County Refining Company, Big Spring, Texas, has been organized with a capital stock of 25,000 shares of no-par value stock to take over and resume operation of a 2500-barrel daily capacity skimming plant formerly owned by Big Spring Refining Company. The plant is located near Big Spring and suspended operations several months ago after having made its first crude runs from Howard-Glasscock district crude in October, 1928. Robert T. Piner, Big Spring, is head of the above new company.

Charles E. Knox, Enid, Oklahoma, has completed construction and is operating a 200-barrel refinery at his Covington, Oklahoma, natural gasoline plant. Equipment and design was handled by Petroleum Engineering, Inc. The plant is automatic in its operation to the end that no additional labor was necessary for its operation.

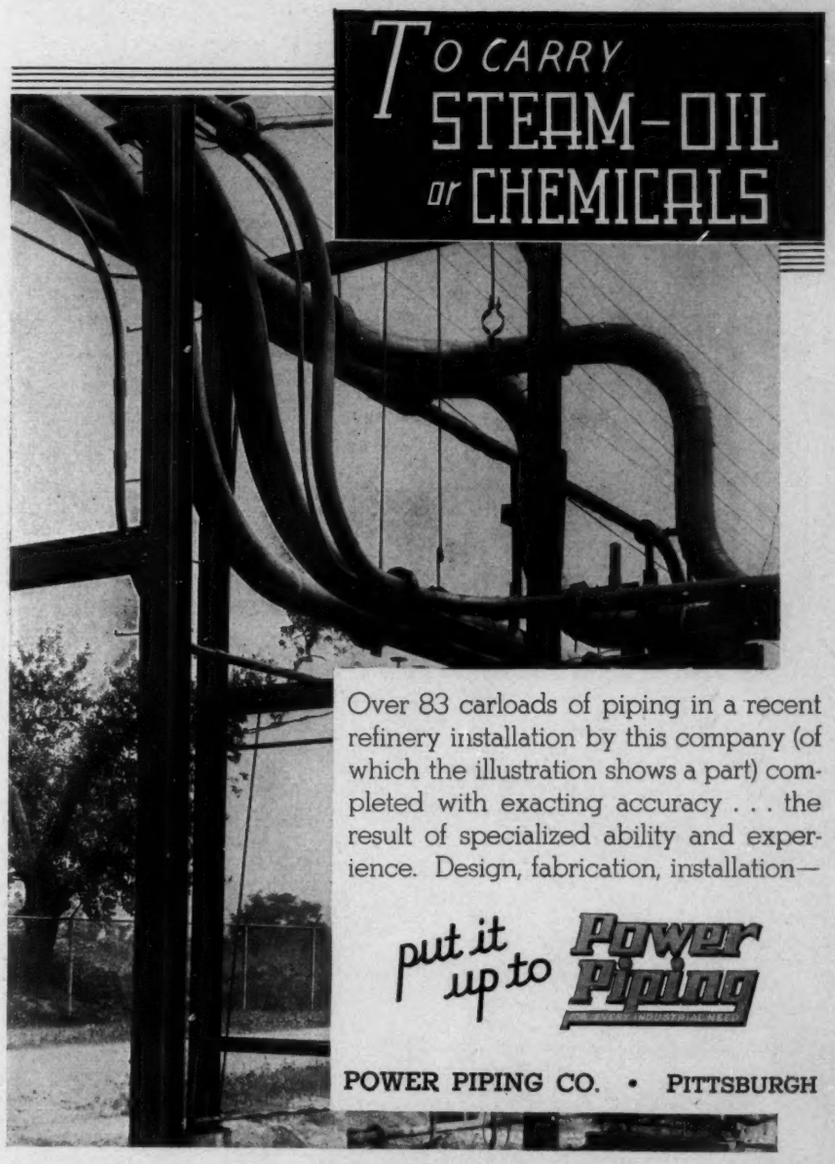
Santa Barbara Asphalt and Refining Company has postponed construction of a refinery near Santa Barbara, California, to handle the heavy crude produced in the shallow Santa Barbara Mesa field. The plant was to concentrate on the manufacture of asphalt, but field and economic conditions are unfavorable for construction at this time.

The Norwalk Company has shut down its small natural gasoline plant near Santa Paula, California, and will not resume operations until market conditions improve.

The Petrol Company, a Los Angeles corporation, recently acquired control of the refinery formerly operated by the Seegar intrests at Bakersfield, and will concentrate on road oils. Kern River crude is ideally suited for this purpose.

Producers & Refiners, Inc., formerly operating a skimming plant in the Torrance, California field, is reported to have suffered seisure by the state for failure to pay gasoline taxes. The refinery owes the state $12,000 for back taxes and the plant will be held until this is paid.

Standard Oil Company, through its subsidiary, Pacific Public Service Com-



Over 83 carloads of piping in a recent refinery installation by this company (of which the illustration shows a part) completed with exacting accuracy . . . the result of specialized ability and experience. Design, fabrication, installation—

put it up to Power Piping

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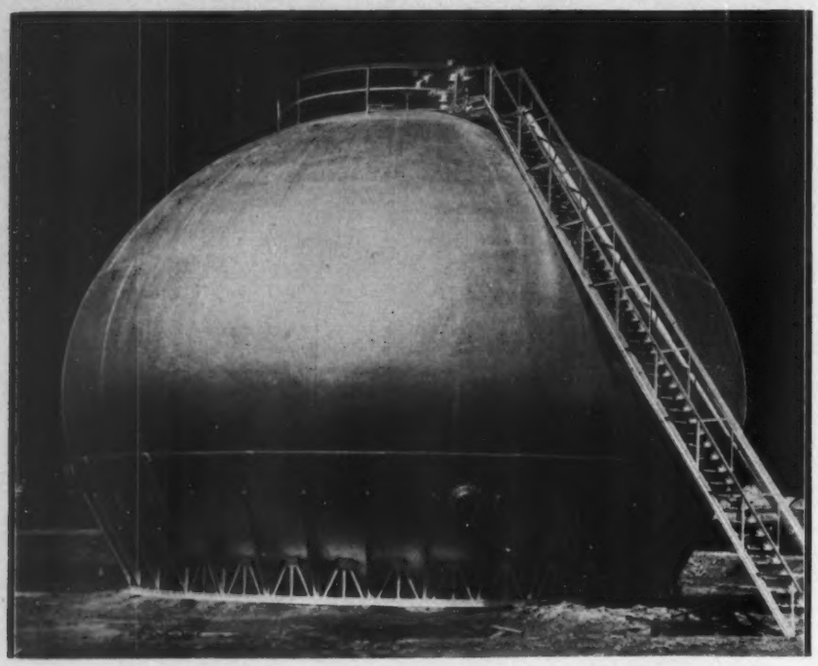
pany, will not immediately carry out its original plan to build about 100 butane plants in California, Washington and Oregon. Twenty plants have been built and placed in operation in these states, but consumption has not indicated the acceptance expected prior to construction of the units.

United Gas Public Service Company has let contract to Stearns-Roger Manufacturing Company, Denver, for removal of the former Dixie-Gulf absorption gasoline plant at Waskom, Texas, to a new site at Refugio, Texas. The plant was designed by the J. A. Campbell Company, Long Beach, California, and this company will have charge of re-designing the installation to increase gasoline capacity from 10,000 to 20,000 gallons daily. Operating pressure is 500 pounds.

H. F. Wilcox Oil & Gas Company has shut down its Panhandle district refinery at Pampa, Texas. Runs have been curtailed also at the company's Bristow, Oklahoma, refinery.

THE HORTONSPHEROID



The accepted storage container for Highly Volatile Liquids

THE *Hortonspheroid*, shown above, has proved effective in minimizing evaporation of light products over a wide range. This tank is built for a working pressure of 10 or 15 pounds, which is sufficient to reduce filling and emptying and breathing losses on all volatile liquids. Under ordinary conditions no air is drawn into the container, nor is vapor vented off. There are no losses so long as the vapor pressure does not exceed the relief valve setting. *Hortonspheroids* are built in capacities of 2,500, 5,000, 10,000 and 20,000 barrels, for 10 or 15 lbs. pressure.

Where higher working pressures are required, due to the excessive volatility of the stored liquid, the *Hortonsphere* is recommended. Designed to withstand an internal pressure of 25 lbs. or more, it is supplied in 5,000, 7,500 and 10,000 barrel capacities.

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Houston.....1126 Electric Bldg.
Tulsa.....2426 Exchange Bank Bldg.
Birmingham.....1548 Fiftieth St., N
Chicago.....2463 Old Colony Bldg.
Detroit.....1520 Lafayette Bldg.
Cleveland.....2234 Midland Bank Bldg.
New York.....3102 Hudson Terminal Bldg.
Philadelphia.2608—1616 Walnut Street Bldg.
Boston.....1529 Consolidated Gas Bldg.
San Francisco.....1051 Rialto Bldg.
Seattle.....4312 Smith Tower
Los Angeles.....1334 Pacific Mutual Bldg.
Havana, Cuba.....Apartado 2507

R 10 Gray

▼ OPERATING ▼

Goshen Oil Refining Company, Torrington, Wyoming, has started operating its 300-barrel skimming plant. M. A. Eaton is president and general manager of the company. E. D. Bishop, formerly with The Texas Company, is in charge of the plant.

Hutchinson Refining Company, recently acquired by Carpenter & Sons, has been undergoing test runs preparatory to resumption of operation. The new owners operate a system of service stations in Iowa. Crude is being secured from nearby producing fields.

Imperial Oil Ltd., at its Sarnia refinery has placed a new unit in operation for the production of high grade lubricants. The process was developed over a period of five years by Dr. R. K. Stratford, chief of the technical and research department. The new process was installed at a cost of $1,000,000.

Lovco Refining Company, Mentone, Texas, is operating a 225-barrel daily capacity skimming plant, located in the Wheat pool in Loving County section of West Texas. Controlling interest in the company is held by Locklar Welding Company of Wink, Texas. The plant produces gasoline, kerosene and fuel oil. Production in the Wheat pool averages about 40 gravity. The products are marketed by truck in West Texas and Southeastern New Mexico.

Oreana Oil Refining Company has rebuilt its plant in the LaBarge field which was recently destroyed by fire, and is again operating on the LaBarge oil field crude. Equipment at the refinery has been augmented to permit of a greater daily thruput which has been required because of the increased market for the plant's products in the locality. Company plans to start making fuel oil soon.

Petroleum Refractionating Corporation, (Bell Oil & Gas Company and Danciger Oil & Refining Company), has completed its 10,000-barrel skimming plant near Longview, Texas. The principle equipment was installed by Southwestern Engineering Corporation.

Phoenix Refining Company, which operates a small skimming plant at Pettus, Texas, is preparing to increase capacity about 50 per cent. A new shell still and tower are being erected. Products are marketed locally.

Signal Gasoline Company of Texas, which operates a natural gasoline plant and skimming plant in the Big Lake field, Reagan County, Texas, is installing equipment for the utilization of a new gas-treating method. This process was developed by L. A. Boyd, district superintendent, and Dr. K. S. Ritchie, research engineer for the company. Treating costs are reported lower through the better utilization of chemicals consumed by the process.

Sinclair Refining Company is progressing rapidly in the reconditioning of its Fort Worth, Texas, refinery formerly owned by Pierce Petroleum Corporation. Most of the equipment going in has been moved into the plant from other Sinclair refineries, especially from the Cushing, Oklahoma, plant which the Sinclair concern is dismantling. The company has recently shut down its Kansas City, Kansas, refinery. At Fort Worth, J. N. Youmans is in charge of reconstruction. Plant capacity is 10,000 barrels daily.

Southport Refining & Export Company, a newly organized company, has started operating a skimming plant at Southport, near New Orleans, Louisiana. Capacity is reported at 4000 barrels. The company was organized by a group of Tulsa oil men owning Looboyle Refining Company. Cornelious Kroll is president and general manager of the company; P. J. Kroll is vice president and sales manager; N. H. Talbott, secretary and Selig Aaronson, treasurer.

Walker Oil Corporation, Wichita, Kansas, and Hobbs, New Mexico, has erected a 300-barrel daily capacity crude skimming plant on its producing property in the south end of the Hobbs field, New Mexico, and is disposing of its output locally. This is the first refinery to be erected in the Hobbs field, Which ranks among the major oil areas of the country. The above company elected to refine its own production when the posted crude price of the field dropped recently to a flat price of 25 cents per barrel, and the price is now 35 cents. Non-producing interests have proposed the erection of plants in the field but were unable to obtain assurance of a continuous crude supply because of the leases being largely held by major interests.

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58% Soda Ash
Caustic Soda

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Leading refiners depend on these products for the quality and uniformity which industry inevitably associates with the name Solvay. First in pioneering the development of American sources of alkali, The Solvay Process Company is recognized as the outstanding leader of its field—first in size and first in facilities for rendering efficient service.

Strategically located distributing points ensure prompt delivery of Solvay products with minimum transportation charges.

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Solvay Sales Corporation
Alkalies and Chemical Products Manufactured by The Solvay Process Company
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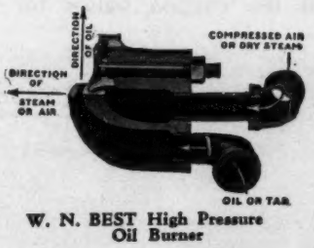

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dependable, efficient, economical, non-clogging atomizers of fuel oils, tars, acid sludges and still bottoms.

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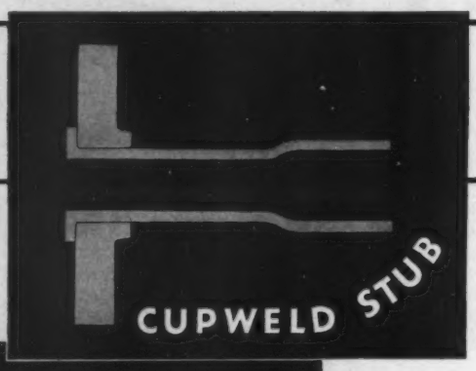
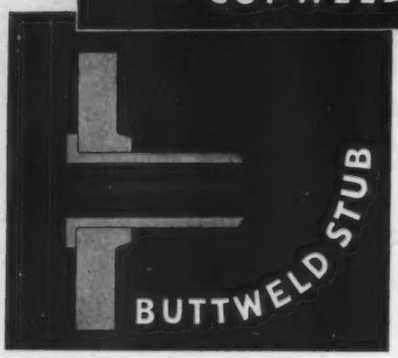




COMBINING THE FEATURES OF THE NAVCO LAP JOINT WITH THE WELDING FLANGE

Navco Welding Stubs with their swivel flanges and completely machined laps, will effect marked economies in your welded piping work ● Their loose flange construction eliminates the aligning of bolt holes ● They are of sufficient length to prevent warping of the faces. Their strong, heavy laps are all carefully machined front and back to insure uniform unit gasket pressure and uniform bearing of the flange. When properly installed they will insure leak-proof construction ● In addition to these features the Cupweld Stub saves considerable time in lining up the pipe—permits longitudinal adjustments of ½ inch and more to be made in the cup—greatly reduces tacking—and insures a more rigid construction with greater strength to withstand bending moments ● For welded pipe work, Navco Welding Stubs will prove the most satisfactory type of connection you have ever used. It will pay you to carry a supply in stock ● Fill out and mail the coupon below for complete details and prices.

NATIONAL VALVE & MFG. CO., PITTSBURGH, PA.
Atlanta Cleveland Chicago New York Philadelphia

NAVCO PIPING SERVICE
ENGINEERING · · · FABRICATION
INSTALLATION

☐ CUPWELD STUB
- ☐ Series 15
- ☐ Series 30
- ☐ Higher Pressures

☐ BUTTWELD STUB
- ☐ Series 15
- ☐ Series 30
- ☐ Higher Pressures

We are interested in Navco Welding Stubs

For _____
(Type of Service)

Name _____

Company _____

Address _____

New Equipment for the Modern Plant

MacCreedy Level Indicator

J. H. BUNNELL AND COMPANY

J. H. Bunnell and Company, 215 Fulton Street, New York, announces the completion and availability of a re-designed and improved model of the MacCreedy Fluid Level Indicator, which is used for automatic gauging of storage, pipe line, and refinery tanks, eliminating the hazards and inaccuracies of manual gauging.

Essentially, the MacCreedy indicator consists of a dual float installed on guide wires inside the tank, which rise and fall with every fluctuation or change of fluid level; a transmitter, from which an electric impulse is transmitted to; and a dial indicator which affords at all times a visual index of the amount of fluid in the tank.

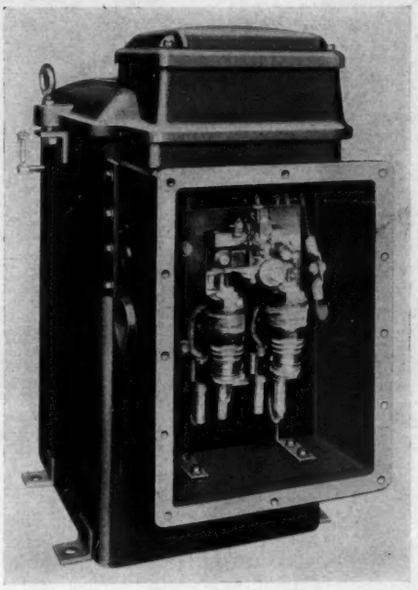
The indicator may be installed at pump house, loading rack, wharf, sea-loading station, tank ship, or at any point however remote from the tank where the impulses originate. Thus, a gauger may stand indoors and gauge a whole tank farm at a glance.

There are no exposed wires or parts, all being protected from fluid, gas, and corrosion. Electrical contacts, of which there are two operating with the rise and fall of the fluid level, are made by flowing mercury to mercury within sealed glass tubes containing inert gas. These mercury switches are said to meet the approval of the Board of Fire Underwriters.

This improved remote control gauge operates to indicate the changes of liquid level within limits of one-eighth of an inch and thus, it is more accurate than the average finding by manual process. Its most important feature is a high and low level visual and audible alarm system, which may be set so as to operate at any desired high and low levels. If, for example, the high alarm is set at 29 feet in a 55,000-barrel tank, the red light will be displayed when the fluid reaches that level; and, more important, an audible signal will commence and continue to operate until the instrument is attended and reset. The low level alarm operates similarly, visually and audibly.

This alarm system is positive and may also be used to control remote electrically operated valves and pumps.

The transmitter and housing are fireproof, gas-proof, and corrosion-proof, having been re-designed in conformity with the requirements of the Board of Fire Underwriters. Working parts are of tempered tool steel. Its electrical features are of simple design, consisting of small storage cells, rectifier, etc., the storage batteries being recommended in order to insure against failure of electric current. Operating voltages are from 24 to 36, direct current.



Explosion Proof Starter

Explosion-Proof Motor Starters

ELECTRIC CONTROLLER & MANUFACTURING COMPANY

Electric Controller & Manufacturing Company, Cleveland, announces a new line of explosion-proof motor starters designed to meet the requirements of Class 1, Group D hazardous locations.

The EC&M Type ZS Across-the-line explosion-proof motor starter provides for full voltage starting of squirrel cage motors. It may also be used with an automatic field switching panel for synchronous motors and may be used for the control of the primary slipring motors.

Some of the primary features of the starter include an oil tank which contains the main line contactor which is equipped with a sight oil gauge and as explosion-proof case, bolted to the rear of the tank, which contains the overload relay panel and which also serves as a conduit connection box. The leads which come from the main line contactor for external connections pass through stuffing boxes located in the top of this explosion-proof case.

The company is prepared to furnish many other forms of starters built in this manner and can design voltage compensator type starters for squirrel cage motors and synchronous motors.

Additional information concerning these starters may be secured by writing the company.

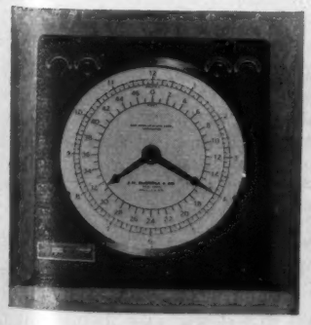
Insulating Firebrick

BABCOCK & WILCOX COMPANY

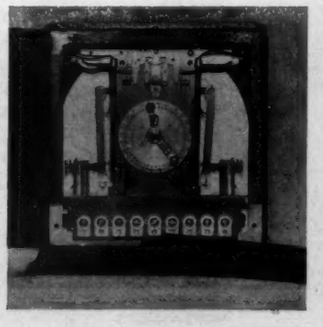
The Babcock & Wilcox Company announces a new insulating firebrick known as the B. & W. No. 80 Insulating Firebrick. Although this material has been previously made experimentally, no practical method of manufacturing it in brick sizes has been developed until recently. The company has now installed the necessary equipment and is producing on a commercial scale.

The No. 80 insulating firebrick is an entirely new building material for furnace work. It may be used without a facing of firebrick on the furnace side, exposed to furnace temperatures and gases and protected only by a coating of No. 80 high temperature or patching cements.

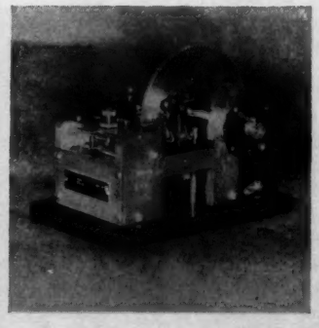
The brick is suitable for lining oil and gas fired furnaces, electric furnaces of the resistance type and for coal-fired equipment wherever it may be used in protection wall areas not exposed to mechanical abrasion and slag action. These bricks may be cut, drilled or



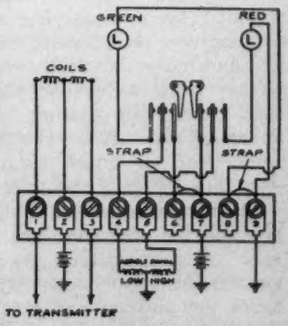
Face of Indicator



Back of Indicator

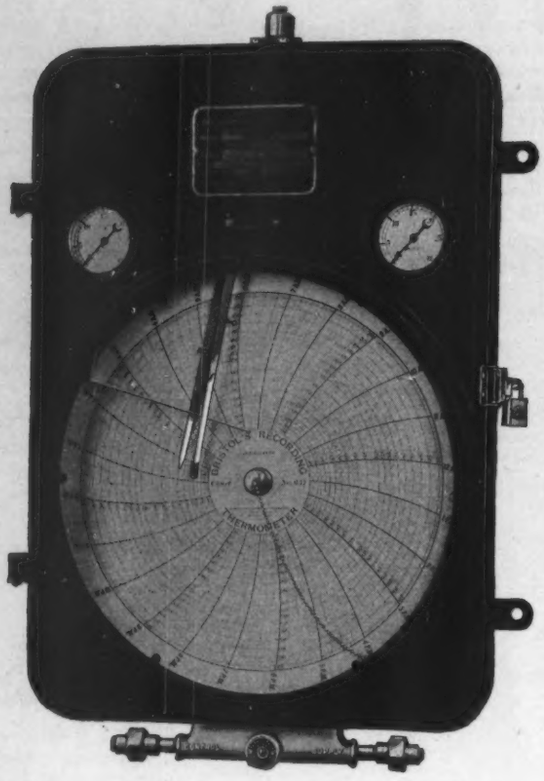


Impulse Transmitter

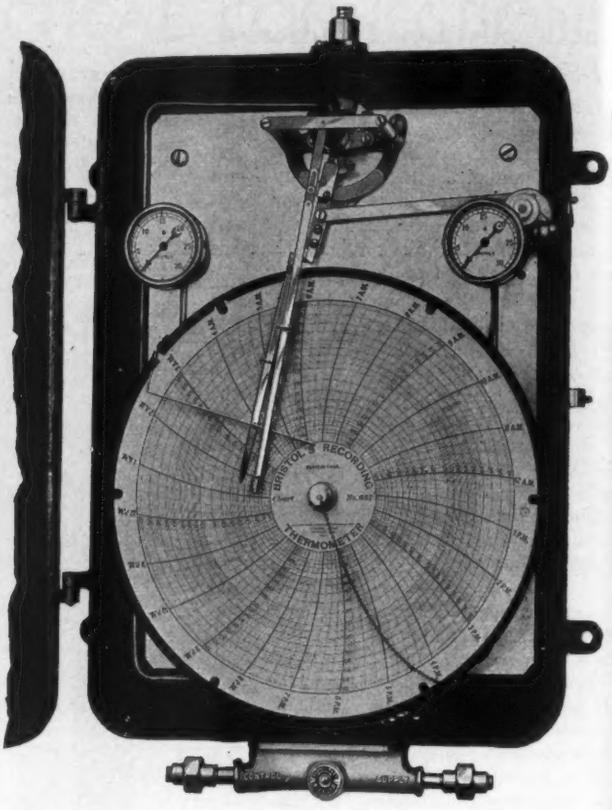


Wiring Plan

NEW EQUIPMENT FOR THE MODERN PLANT



Bristol No. 3279



Bristol No. 3280

shaped with ordinary woodworking tools.

A new bulletin, titled "B. & W. Insulating Firebrick," has been published to present this new firebrick, and a copy will be sent upon request to the company office at 85 Liberty Street, New York City, or to a district representative.

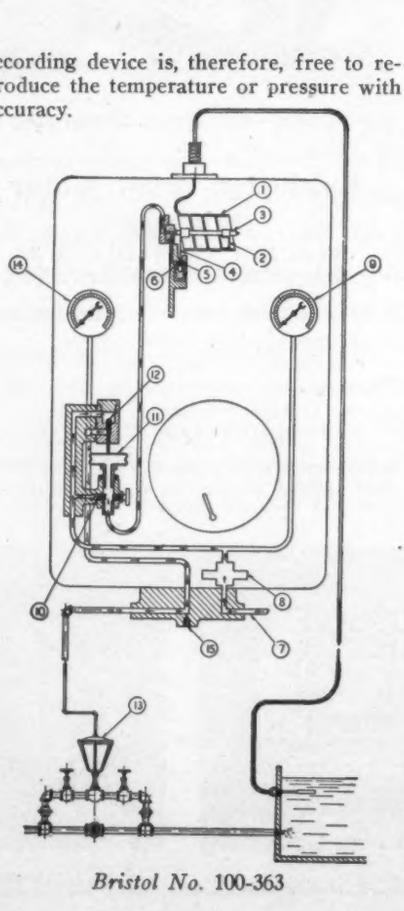
Recording Controllers

THE BRISTOL COMPANY

The Bristol Company, Waterbury, Connecticut, is offering a new line of air operated recording controllers, employing a "free vane" as the initiator of control, which is a new departure in air operated control.

The "free vane" is attached to and actuated by a measuring element of a temperature or pressure recording system and moves between two air jets with stream lines coinciding placed opposite each other. In passing into these air streams, the "free vane" varies the amount of air which escapes from the jets, thus effecting control.

The arrangement and design of the two jets and the free vane are such that the vane floats between two equal air streams at right angles to its motion, hence the position and movement of the measuring elements are not affected. The recording device is, therefore, free to reproduce the temperature or pressure with accuracy.



Bristol No. 100-363

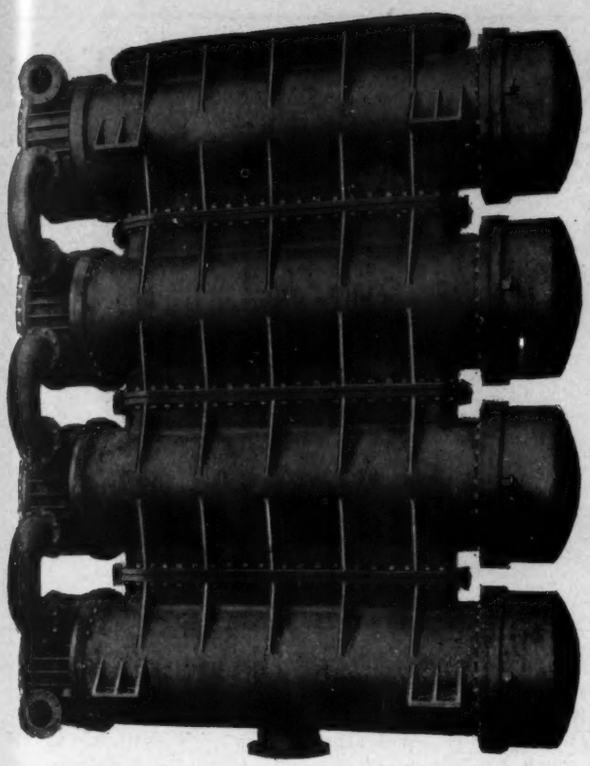
Control from a frictionless device as described above permits the use of supersensitive measuring systems to which The Bristol Company has always been committed. With this sensitive measuring system are also co-ordinated the other well known Bristol's features of ruggedness and simplicity.

The component parts are easily accessible although compactly assembled. The point of control is easily set to a visible scale point by means of a key.

The free vane recorder controller is enclosed in a two part cast-aluminum case of moisture-proof construction. It is furnished with inverted penarm and fountain pen as standard equipment. The chart is rotated by a powerful spring clock or Bristol's telechron operated clock. The case is available for wall or flush mounting. Furnished as a single or two-pen instrument in combination of pressure or temperature and has a pressure range up to 1500 pounds per square inch and temperature range up to 1000°F., using 12-inch charts. Temperature measuring systems may be either vapor or gas filled, depending on the operating temperatures encountered.

Patents covering this method of control are applied for and pending.

A new catalog, No. 4001, fully illustrating and describing this instrument is ready for distribution.



The G-R Sectional Condenser

THE G-R Sectional Condenser has a number of features which promote a high efficiency in condensation and subcooling.

The large area of the "ob-round" nozzles, which are used for high vacuum work, results in low pressure drops and assures even distribution of the vapor over the condensing surface.

The sectional construction makes for ease in handling, allows the use of two or more cooling mediums in the several sections and permits the ready addition of more sections to provide for increases in capacity.

Special features of design result in long travel and high velocity of the circulating liquids, minimize temperature strains, assure complete protection against leakage, and permit easy inspection and cleaning.

These units are suitable for condensing vapors with or without subcooling of condensate, as well as partial condensers and vapor heat exchangers.

The Griscom-Russell Co., 285 Madison Ave., New York

Branches in Principal Cities

Griscom-Russell

Heat Transfer Apparatus

FOR SOUTHWESTERN REFINERS

TEXAS FIRE BRICK

BUTLER

Elgin Butler Brick Co., Austin, Texas

COLEMAN

Athens Brick & Tile Co., Athens, Texas

STANDARD

Acme Brick Company, Ft. Worth, Texas

E B H TEXAFRAX

Texas Clay Products Co., Malakoff, Texas

A Quality Product

QUICKLY AVAILABLE AT LOW COST

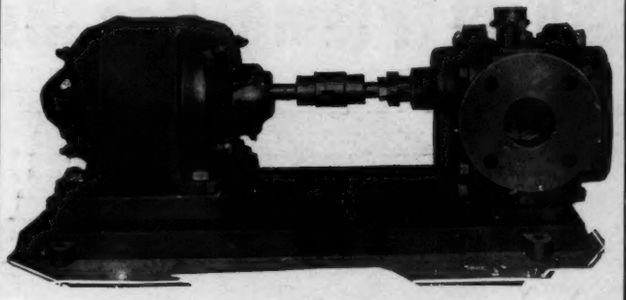
Texas Fire Brick meet refractory requirements ordinarily expected of higher priced brick. Shipped to Southwestern points at an appreciable saving in freight. Time-saving short hauls from large stocks.

Write for prices.

FIRE BRICK DIVISION

of the SOUTHWEST CLAY PRODUCTS INSTITUTE

ADDRESS ANY MEMBER LISTED



S&K GEAR PUMPS

handle all oils–

light or heavy, hot or cold

Special balancing feature insures long life.

Built for pressures up to 1500 lbs.

New bulletin gives complete information.

SCHUTTE & KOERTING

1253 N. 12th Street

PHILADELPHIA, PA.

NEW EQUIPMENT FOR THE MODERN PLANT

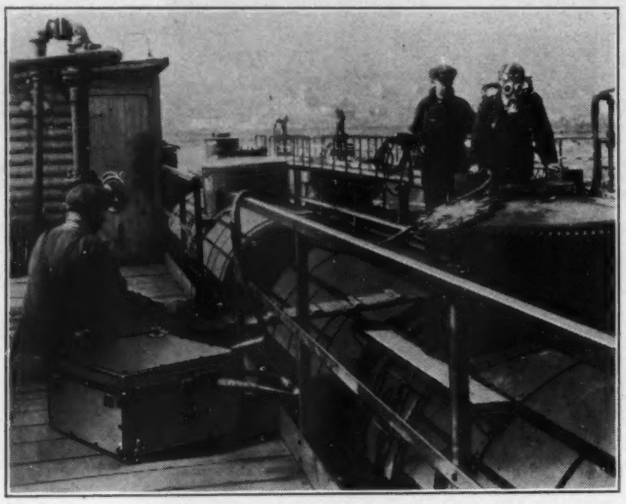
Hose Masks

MINE SAFETY APPLIANCE COMPANY

Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, announces having placed on the market the new M-S-A hose masks. These masks have an all-rubber face piece, fibre trunks of improved design, with motor driven blower units that are 100 per cent ball bearing. The new safety outfits are furnished in two and six-man mask assemblies. Five distinct models are offered, including the combination, the standard, the special, the motor driven, and the motor-hand driven.

The M-S-A combination and standard hose masks are now equipped with large ball bearing blowers, mounted in waterproof trunks, of improved design, and are available in assemblies with one-inch medium weight oil-proof hose or seven-eighths inch hose as desired, or in one or two-man outfits as desired. They have twice the air capacity of previous models. The blower furnishes ample fresh air for two men when the hose is provided with "Y" connection.

The trunks are made of durable, waterproof fibre materials. Only the used portion of the hose need be withdrawn from the closed trunk, as needed, through a slot in the side of the case. The handle is held in place in the trunk when not in use, and the blower of the trunk is operated with the trunk closed, protecting the trunk against rain.



Mine Safety Hose Mask

The M-S-A combination hose mask is officially approved by the U. S. Bureau of Mines for safe use in highly concentrated gaseous or oxygen deficient atmospheres with as much as 150 feet of one-inch medium weight oil-proof hose. Both the M-S-A combination and standard hose masks are officially approved by the American Gas Association.

Further information on these new masks is available by writing the company.

Short Flame Gas Burners

Burn Rectifying Column Vapors and Still Gases

WITH A SHORT FLAME

Without Excess Air

Over Six Thousand John Zink Burners in Use

JOHN ZINK COMPANY

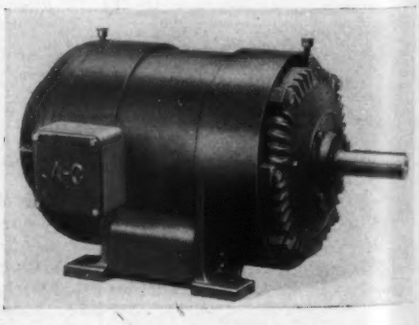
Oklahoma Natural Gas Building — Phone 4-9838

TULSA, OKLAHOMA

Explosion Proof Motor

ALLIS-CHALMERS MANUFACTURING COMPANY

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, has developed new line of explosion-proof motors that is approved for use in hazardous atmospheres such as are encountered in oil refineries, gasoline plants, paint, varnish and lacquer plants, and similar installations where explosive atmospheres are encountered. These motors have been tested and approved by the Underwriters' Laboratories, and carry the laboratory label for use in Class 1, Group D locations, gasoline, (pyroxoline, lacquer vapor.)



Allis-Chalmers Motor

The construction of this explosion-proof motor is along the same general lines of the Allis-Chalmers totally enclosed, fan-cooled motor, having the same simple de-

Type U Operator

HAVE YOU INVESTIGATED THE S & J IMPROVED HYDRAULIC INTERNAL VALVE SYSTEM FOR TRUCK TANKS

TYPE-U improvements include . . .

Fool Proof Non Pumping Operator By Passing principle insures full valve opening.

Air bled from system from outside. Leak proof valve seats.

Easy operation. Low pressure. Concealed operating mechanism assures cleanliness of installation.

Added simplicity of mounting. Positive guarantee of satisfaction. Simplicity permits replacement of any system on present old equipment.

A trial will convince you too why over 70 oil companies are using S&J Hydraulic Internal Valve System.

Added safety insured by Ignition Control prevents operating motor while valves are open. Fuse plugs close valves in case of FIRE.

You are protected in using the above features and the Hydraulic System by the Generic Patent No. 1524054, also Patent Nos. 1801749, 1801750 and others pending.

Type U Internal Valve

Tank Manufacturers who maintain large stocks of S&J Hydraulic Valves.

The Heil Co., Standard Steel Works, Columbian Steel Tank Co., Quaker City Iron Works, Butler Manufacturing Co., A. F. Robinson Boiler Works, The Boardman Co., Puget Sound Sheet Metal Works.

Send for Bulletin No. 51

Fusible Plug

Ignition Control

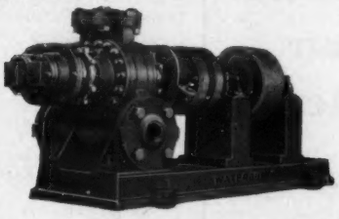
Protect Your Refinery by Using S&J Valves on Your Truck Tanks

SHAND AND JURS CO.

BERKELEY, CALIFORNIA

New York Denver Tulsa Los Angeles Seattle Houston

WATEROUS



ROTARY PUMPS built strictly to one standard—that of the utmost in quality, design, workmanship, and material. Trouble-free service is the first consideration—first-cost is secondary. Complete information upon request.

Waterous Dependable

Agents in Principal Cities
WATEROUS COMPANY
St. Paul, Minnesota

SOUND DESIGN

UNION HOISTS

Guaranteed for Five Years

FIFTEEN FEATURES: Steel reversible load sprocket on heat treated solid steel axle. Large roller bearings, enclosed in cages. Alloy steel cut gears, heat treated. Exclusive pressed steel plate suspension, accurately spaced, securely bolted. Gear system and other moving parts enclosed in dust-proof steel cases. Hand-wheel shaft and driving pinion supported beyond intermediate gears. Welded chain, made of high carbon steel, die formed and heat treated. Forged steel hooks. Improved chain guide. Less handling of chain to lift a given load. Extra heavy driving pinion. Visible self-cleaning and self-closing lubrication system. And final tests to 150% of rated capacity.

Send for a Catalogue of Union Hoists. Also, for your machine shop, UNION CHUCKS.

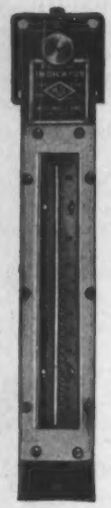
Union Manufacturing Co.

NEW BRITAIN, CONNECTICUT

Branch Offices Carrying Stocks:

NEW YORK, 26 Cortlandt St.; CINCINNATI, 332 Sycamore St.; CHICAGO, 27 S. Jefferson St.; SAN FRANCISCO, 661 Folsom St.; HOUSTON, I. Van Tassel, 1120 Union National Bank Building.

NOW READ
your flow conditions
. . . at a glance
with the



MJL Flow Indicator

Accurate knowledge of process flow, *economically* obtained, is vitally necessary in all Refineries under present conditions. With the M. J. L. Flow Indicator you read flow of gases, water, oils, air, steam or chemicals *directly* in their proper units—no charts to figure . . . . Cost much lower than recording meters.

Close Hook up Type mounts directly on the flow line, handy to control valve. Operators appreciate the unique convenience of this type.

Remote Hook up Type permits mounting Indicator at any convenient distance from the pipe line—as in a meter house or operator's quarters.

Bulletin 208 tells *how* . . .

MJL

Send for *your* **copy**

MOREY & JONES, Ltd.

Manufacturing Engineers

926 So. Hemlock Street Los Angeles, California

Relief for your Tanks

Protection for your Meters

CF

Vacuum Relief Valve Regulators

In case of line stoppage or other causes that result in the pulling of a Vacuum in storage tanks and purifiers, this Regulator comes quickly to the rescue. It is placed in a line between suction and discharge of compressor so that, should the pressure in the suction line to the compressor drop to zero, the Relief Valve will open and relieve the vacuum tendency. For a vacuum of 8 oz. or less, use the Duplex Regulator shown above. For higher vacuums use the single diaphragm Vacuum Relief. Action is reliable. Thousands of meters and tanks have the constant protection which this C-F offers you.

Data upon request.

The Chaplin-Fulton Mfg. Company

Organized 1884—Oldest Builders of Gas Regulators in the Country. Built in all Sizes, From 1 Inch to 24 Inches; For all Service. 1 oz. up to 2,000 lbs. Pressure to Square Inch

28-40 Penn Avenue *Representatives:* Pittsburgh, Pa.

Westcott & Greis, Inc. Jno. W. Crawford

Sales Service: Dallas—Los Angeles—Tulsa *Sales Engineers:* 1855 Industrial St., Los Angeles Or Any Jobber

sign, with all parts readily accessible. Its special features include extra long bearing seals to prevent the escapment of flame and to cool the gases below the point of ignition, special alloy steel cap screws that fit into tapped pockets, and unusual sturdiness to safely resist stresses due to possible internal explosions or flashes. In addition to the sealed motor leads, a special explosion-proof cast iron conduit box gives additional protection against possible contact with surrounding air.

Purox Welding Torch and Cutting Attachment

LINDE AIR PRODUCTS COMPANY

Linde Air Products Company, 30 East 42 Street, New York City, has made two new additions to its line of Purox medium pressure apparatus for oxy-acetylene welding and cutting.

The new Purox No. 11 welding torch, which supersedes the Purox No. 10 torch, has a very wide welding range extending from the lightest sheet metal up to work as heavy as ½-inch plate. In spite of this wide range the torch is very light in weight and has perfect balance. The tips are of one-piece, hard-drawn copper construction and are so designed that the head angle can be easily adjusted as desired by the user. Tips Nos. 2, 4, 6, 8, and 10 are furnished as standard equipment.

The Purox No. 21 cutting attachment designed for use with the Purox No. 11 welding torch will cut metal up to two inches in thickness. It is furnished with one and two-piece Purox cutting tips. By means of this cutting attachment the welding torch can be easily and quickly converted into a cutting torch. This is the lightest cutting attachment on the market, weighing only one pound eight ounces.

An adapter is also available which makes it possible to use the Purox No. 21 cutting attachment with the Purox No. 20 welding torch.

Abrasive Pump

AMERICAN MANGANESE STEEL COMPANY

American Manganese Steel Company, Chicago Heights, Illinois, has added the new type "C" to its line of abrasive materials handling pumps.

This new pump is strictly AMSCO in design, is made of AMSCO manganese steel, and is offered the trade at unusually low cost.

Many new features have been included in these pumps; the bearings are interchangeable in the field, either sleeve or anti-friction types being available—lubrication is required only on main bearings (except where outboard bearings are used)—impeller clearance and main bearings can be adjusted easily without dismantling—thrust and radial shocks are completely absorbed by new bearing arrangement.

Square and Triangular Mesh

Floor Gratings and Stair Steps

The strongest and lightest

Bridge and Floor Slabs
(Monolithic)

Catalogue and Prices on request.

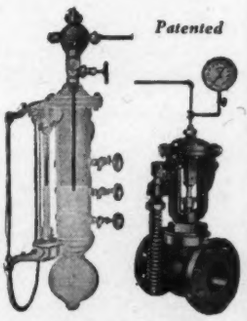
KERLOW
Steel Flooring Company
222-228 Culver Avenue
JERSEY CITY, N. J.

See Telephone book for Representatives

"I am pleased . . .

to inform you that we have 15 Campbell Boiler Feed Water Regulators in use in this district and they are taking care of our boiler feed regulation very satisfactorily. In fact they are the only regulators we have tried out that operated positively and lived up to the claims made by the manufacturers."

The above letter is from the superintendent of plants of a large oil refinery. Name on request. They are now using a total of 45 Campbells. No wearing parts. No floats. No thermostats. No generators. No links.



Ask for list of refiners using the CAMPBELL.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
275 South St., Newark, N. J.

On which do you want information?

- ☐ The Campbell Boiler Feed Water Regulator
- ☐ Reducing Valves
- ☐ Damper Regulators
- ☐ Exhaust Control System
- ☐ Temperature Regulators
- ☐ Pump Governors
- ☐ Float Valves
- ☐ Swing Joint Fittings
- ☐ Bronze Unions
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

ITEMS ABOUT MANUFACTURERS

American Manganese Steel Company, Chicago, has appointed W. C. Bruton district sales manager for the pacific Northwest territory comprising Oregon, Washington, British Columbia and the Coeur D'Alene district of Idaho. Mr. Bruton, for many years Amsco sales engineer working from the Oakland, California, office, will be assisted in the sale of Amsco products by Agency Representative P. R. Hines, Lewis building, Portland, and by Paragon Supplies, Ltd., 845 Hastings Street, East Vancouver, British Columbia. Both agencies have been connected with the company for many years.

A. C. Fickes

The Biggs Boiler Works Company, Akron, Ohio, has appointed Alfred C. Fickes sales manager. Mr. Fickes, for the past eight years, has been general sales manager of Lancaster Iron Works, Lancaster, Pennsylvania, and is well known in steel plate fabricating lines. He has been identified with the steel industry for many years, as a mechanical and structural engineer with Philadelphia and Reading Coal and Iron Company, Lehigh Coal and Navigation Company, Southern Pipe Line Company, Bethlehem Steel Company, and McClintic-Marshall Construction Company, before entering the service of Lancaster Iron Works in 1915 as chief engineer.

Philip Carey Company has placed R. T. MacEachern, formerly of Tulsa, in charge of its office located in the Magnolia building, Room 417, Dallas. Mr. MacEachern will continue in charge of the company's Tulsa office, located in the Mayo building, Room 733.

Columbia Alkali Corporation recently announced the modernization of the trade term applying to its soda ash and caustic soda. It has been customary in the past to refer to caustic soda as 76 per cent strength, and to designate soda ash as 58 per cent strength. The figures represent the calculated sodium oxide equivalent and not the actual soda ash or caustic soda content. Columbia Alkali Corporation proposes to use the correct designations in the future, and this step should prove beneficial to consuming industry, and term the products Columbia 98 per cent—100 per cent caustic soda and soda ash. The new nomenclature will tend to eliminate confusion, especially among those not intimately familiar with these two important chemicals.

Caustic soda is produced and shipped by this company in solid form, flake, ground and powdered forms and in liquid state. Soda ash is shipped as light, dense, and feather ash.

Columbia Alkali Corporation, a division of Pittsburgh Plate Glass Company, and one of the oldest and largest manufacturers of soda ash, caustic soda and allied chemical products in the United States, has established a new office in Dallas located in the Santa Fe Terminal building, and will become the Southwestern sales headquarters of the company, with jurisdiction over Texas, Oklahoma, Louisiana and Arkansas.

K. C. Frazier, who has had considerable experience in the merchandising of Alkalis to the principal consuming industries, has been appointed Southwestern manager, and has already initiated an organization plan for the territory.

It is of interest to consumers of soda ash and caustic soda to know Columbia Alkali Corporation is closely identified with The Southern Alkali Corporation, Corpus Christi, Texas, where a new plant designed for the manufacture of these important chemical items is now under development.

Coen Company announces removal of its offices and warehouse to 915 Bryant Street, San Francisco. Coen Company, Combustion Engineers, and manufacturer of a complete line of burners and heaters, and maintains offices in San Francisco, Los Angeles, Houston and New York City.

P. E. Fluor, general manager of Fluor Corporation, Ltd., has just returned from a Mid-Continent trip, during which he inspected the progress on the Missouri-Kansas national gas pipe line. Fluor Corporation, Ltd., is now installing its third compress station on this line.

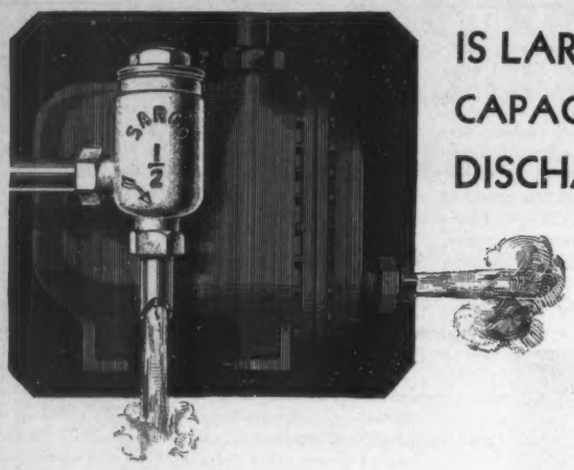
Graver Tank & Manufacturing Company, East Chicago, Indiana, announces the appointment, September 15, of Walter M. Mount, who for many years has been associated with the oil industry. From his headquarters at 1448 South Carson Avenue, Tulsa, he will handle Graver sales in Kansas, New Mexico, Texas and Oklahoma. Mount has maintained headquarters in Tulsa since 1912.

International-Stacey Corporation, Columbus, Ohio, has transferred B. T. Ehrnman, formerly located in the Chicago office of the International-Stacey Corporation, to St. Louis as division manager with offices at Room 2192 Railway Exchange building.

Mr. Ehrnman has been associated for a number of years with the Roots-Connersville-Wilbraham division of this company in the sale of gas pumps, meters, blowers and other equipment. With the opening of the St. Louis office he will also have charge of the sale of Ideco oil and gas drilling and pumping equipment, Stacey Brothers Telescopic, "Bullet" Pressure and Stacey-Klonne Dry Seal Gas Holders, Ideco standard steel buildings, Ideco airport and airway equipment and Ideco electrical equipment in addition to the Roots-Connersville-Wilbraham line of products.

Maintenance Engineering Corporation, 1400-2 Conti Street, Houston, Texas, announces that arrangements have been made to represent Mason Regulator Company of Boston, Massachusetts, in this territory, which concern is now associated with Neilan Company, Ltd., of Los Angeles, California, which Maintenance Engineering Corporation has been representing for the past several years.

NO STEAM TRAP



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Items About Manufacturers

Mathieson Alkali Works, Inc., New York City, has made Hoke Martin technical adviser for the Chicago and Tulsa territories with headquarters in the Chicago office, 2039 Straus building. Mr. Martin formerly had charge of the Tulsa office. This position is now held by T. J. Boye, who was transferred from the Dallas office.

Northern Equipment Company, Erie, Pennsylvania, announces the appointment of W. J. McDonough to its engineering staff. He served this company as field engineer from 1921 to 1927, after which he has been connected with Kissick-Fenno Company, New York City.

C. J. Tagliabue Manufacturing Company of Brooklyn recently announced the promotion of A. F. Rucks to the position of general sales manager. Mr. Rucks has been connected with the Tagliabue Company for 18 years and for the past four years has served as assistant to L. C. Irwin, vice president of the company.

O. F. KLUENTER

Webster Engineering Company, Tulsa, has placed O. F. Kluenter in charge of the company's Eastern office with headquarters at 117 Liberty Street, New York. Mr. Kluenter has been sales representative for the company in the Mid-Continent field. Webster Engineering Company is a subsidiary of Surface Combustion Company, Toledo, Ohio, which in turn is a subsidiary of Henry L. Doherty & Company.

Worthington Pump & Machinery Corporation, Harrison, New Jersey, announces, following a recent meeting of its board of directors, the election of LaMonte J. Belnap as chairman of the executive committee of the corporation. He is succeeded as president by Harry C. Beaver, formerly vice president. As chairman of the executive committee, Mr. Balnap maintains his active part in directing the manufacturing, sales and financial activities of the corporation. He is known internationally as a financial and industrial leader. The new president has been associated with Mr. Belnap in various enterprises for the past 25 years.

Hiergesell Brothers, Philadelphia, has recently issued general catalog "H" on scientific instruments, which covers 112 pages of fully descriptive matter, with pictorial illustrations, on the large line of instruments manufactured by this company. A copy is available by writing the company.

Catalogs—Bulletins—Books

Babcock & Wilcox Company, 85 Liberty Street, New York City, has published three attractive bulletins, covering its cements and plastics, laboratory furnace, and its insulating firebrick. Copies of the bulletins are available upon request.

The cement and plastic publication describes the various refractory cements and plastics manufactured by the company and outlines their uses and method of application. The bulletin is fully illustrated with photographs of installations. Various tests, such as settling tests and cracking and shrinkage tests are described and illustrated by photographs. An interesting discussion of the modern trend in refractory cements, including the properties required of a refractory cement, is included.

The insulating firebrick bulletin discusses a new firebrick with insulating properties, an entirely new building material for furnace work, which, the company states, has not only insulating qualities better than the majority of high quality insulators but refractory characteristics that compare favorably with any high grade firebrick. These characteristics are illustrated by means of curves and sketches and calculations. A division of the bulletin is devoted to the advantages secured by the use of this material. Examples are given to illustrate each point.

The furnace laboratory bulletin describes a new quick-melting compact and simple high-temperature crucible-furnace for melting small samples of ceramic materials or non-ferrous metals or for other laboratory purposes such as, heating metals for treatment. Photographs of the furnace are shown together with a list of uses and the specifications of the furnace. A section of the bulletin is devoted to a description of the properties of the furnace such as, high crucible temperature, quick heating, and convenience. These properties are illustrated by graphs and tables. A chart showing thermocouple calibration curves illustrates the use of the furnace for calibrating thermocouples from the freezing points of metals.

Merco Nordstrom Valve Company, 343 Sansome Street, San Francisco, has issued a 172-page catalog, illustrating approximately 30 types of Nordstrom lubricated plug rock valves.

The catalog lists various types of valves made in different metals for handling different liquids, semi-liquids and gases, both neutral and acid; and it also lists steam jacketed valves, remote control valves and types with multi-ports, both in low and high pressure. Valves manufactured of bronze, aluminum and Mercalloy for handling corrosion-resistant liquids are also shown, and the catalog is illustrated with actual installations in approximately 20 industries.

Taylor Forge and Pipe Works, of Chicago, has just issued Bulletin 31-1, devoting 32 pages to covering Taylor forge fittings—new seamless steel pipe fittings for welding. The bulletin is profusely illustrated, and tables carried on the various items give a complete line-up on sizes and prices. A copy of Bulletin 31-1 is available by writing the company at P. O. Box 485, Chicago, Moorlane Company, Mid-Continent distributors, located at 409-11 East Archer Street, Tulsa.

C. J. Tagliabue Manufacturing Company, Brooklyn, New York, announces a new and very complete 16-page catalog describing and illustrating the full line of TAG flow instruments which comprises flow recorder-controllers for liquids, flow meters and orifice meters for gases, flow recorder-controllers for gases and liquid level recorder-controllers. Following its usual custom the company has included in this catalog numerous photographs and diagrams of applications which make it far more than a mere compilation of uninteresting facts and figures.

J. E. Lonergan Company, Philadelphia, has issued a new catalog, No. 400, describing 300 specialties for power plants. These specialties consist largely of valves, oil and water gauges, oil cups, oil devices and whistles.

A copy of the illustrated catalog may be obtained by writing J. E. Lonergan Company, 211 Race Street, Philadelphia.

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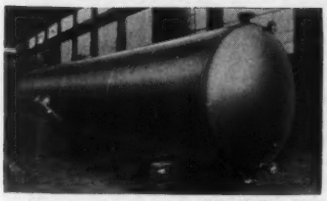
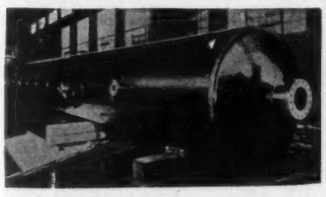


Welded Butane Gas Receiver



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